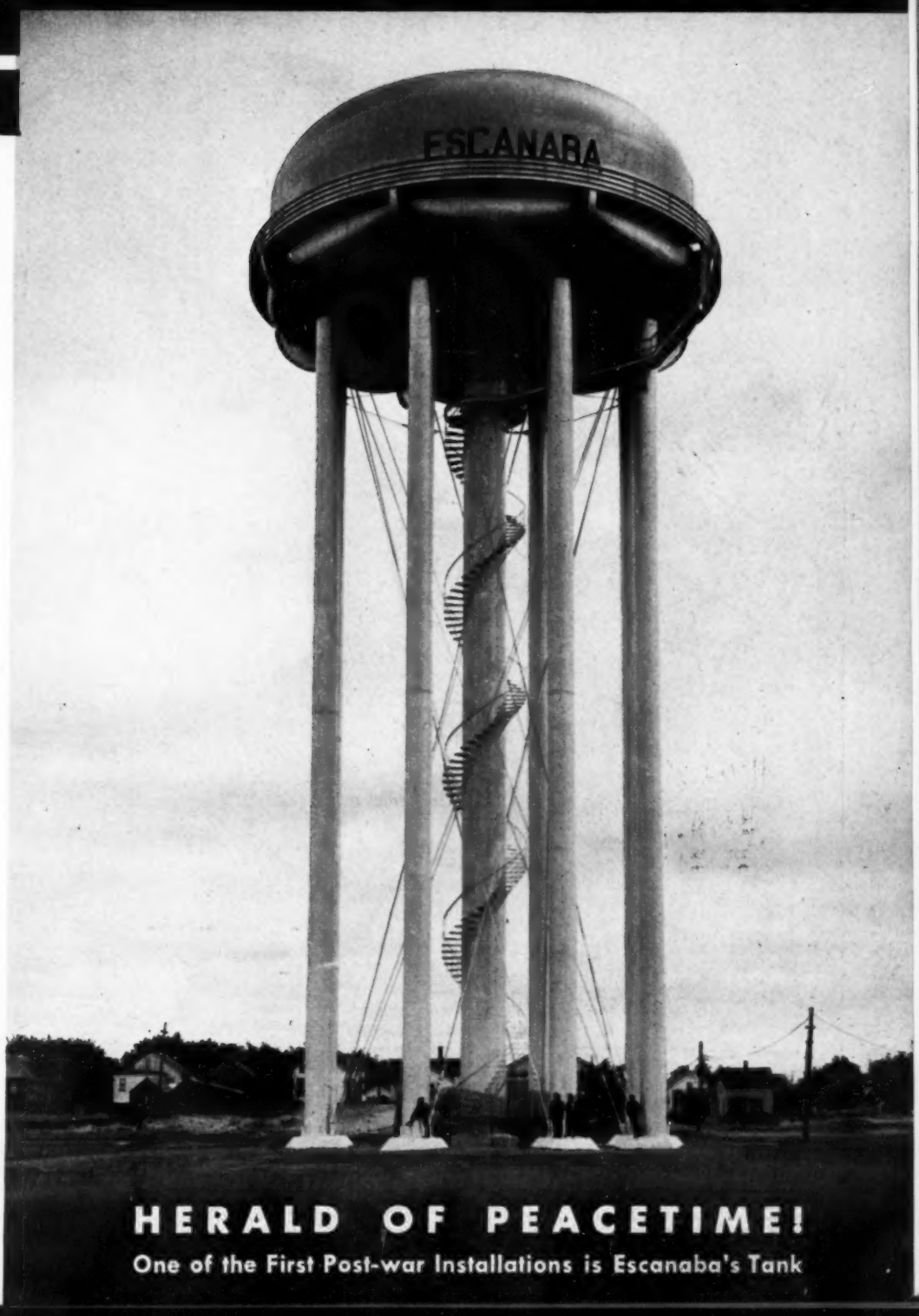
WATER & SEWAGE WORKS



HERALD OF PEACETIME!

One of the First Post-war Installations is Escanaba's Tank

A GILLETTE

PUBLICATION

FIRST AID FOR WATER MAINS!

Perchloron

REG. U. S. PAT. OFF.

Instantaneous sanitizer for emergency breaks!

The breakage of a water main at any point allows pollution to enter the water supply. Perchloron added to the water safeguards the supply by aiding in the elimination of such pollution.

Water works engineers have found Perchloron a dependable stand-by for just such emergencies because of its quick solubility, greater stability and high chlorine content.

In the water purification field, PERCHLORON is also used to sanitize small water systems, new mains, wells and swimming pools. Its properties include the oxidation of ferrous iron in water, the removal of hydrogen sulphide, the control of most types of algae and the destruction of chlorine susceptible bacteria.

PERCHLORON has been released by the military and is now available. Orders will be filled as promptly as we can meet demands.

PENNSYLVANIA SALT MANUFACTURING COMPANY

Chemicals

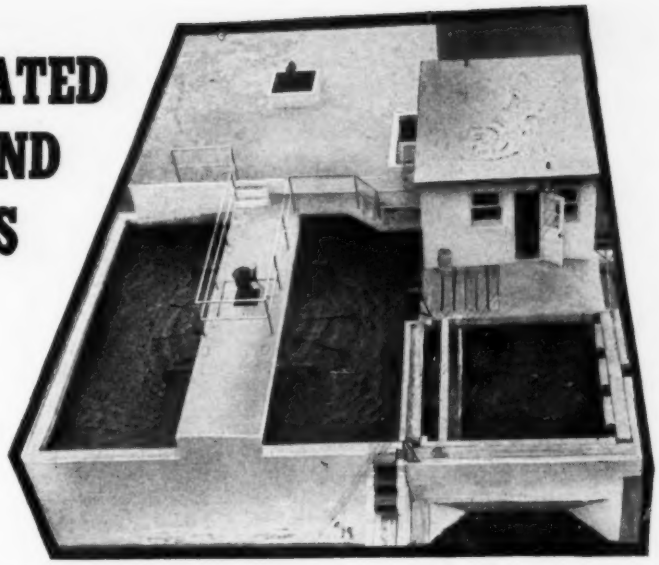
1000 WIDENER BUILDING, PHILADELPHIA 7, PA.

New York • Chicago • St. Louis • Pittsburgh • Cincinnati • Minneapolis • Wyandotte • Tacoma

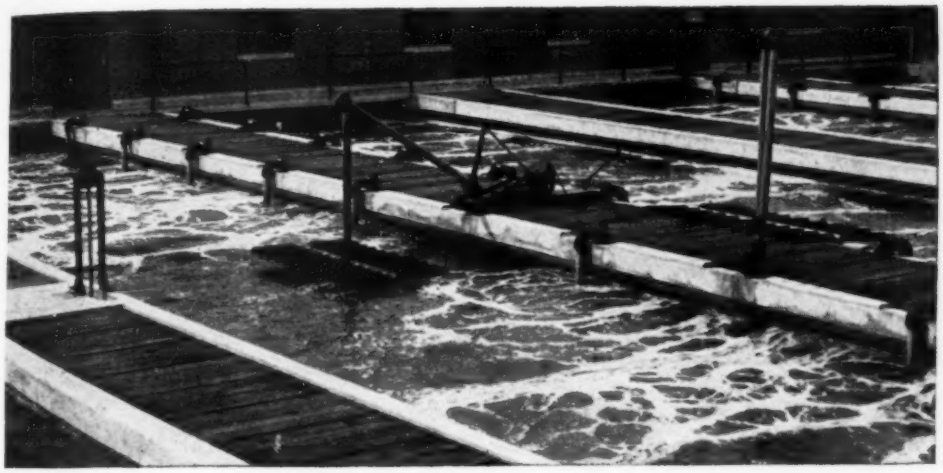
WATER AND SEWAGE WORKS, January, 1946. Volume 93, Number 1. Published monthly by Gillette Publishing Co., 330 South Wells Street, Chicago, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under act of March 3, 1879.

165 OF 300 NEW ACTIVATED SLUDGE PLANTS SHOW TREND TO "CHICAGO" PROCESS EQUIPMENT

These Plants Have Continuous Records of Successful Process Control for Simple Operation



Chicago "Package" sewage treatment plant at Consolidated-Vultee Aircraft Corp., Miami Springs, Fla.



Chicago Wide Band Air Diffusion System with Swing Diffusers at Omaha, Neb., Sewage treatment plant.

REASONS WHY

Specialization in equipment and process control since 1933. Equipment rationally designed for process control requirements.

Overall application engineering service based on 12 years operating experience.

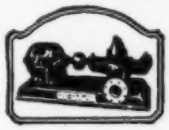
Initial operation and regulation and operator training goes with each "Chicago" equipped plant.

We shall welcome the opportunity to send you recommendations and equipment application information for your specific problems.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

2349 WOLFRAM STREET — **CHICAGO 18, ILLINOIS**



Flush-Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clogs, Water Seal Pumping Units, Samplers.

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

"Revive" Failing Sewers THIS EASY, PERMANENT WAY

Relining failed sewers is easy and quick — and permanent — with long lengths of sturdy ARMCO Asbestos-Bonded Pipe.

★ ★ ★

You can give failing sewers many more years of useful life by relining with durable, easy-to-install ARMCO Asbestos-Bonded Pipe. Job costs are low and the work moves fast. Long lengths of pipe, quickly joined with special inside band couplers, speed the job. Waterway is reduced a minimum because of the relatively thin walls of the corrugated pipe.

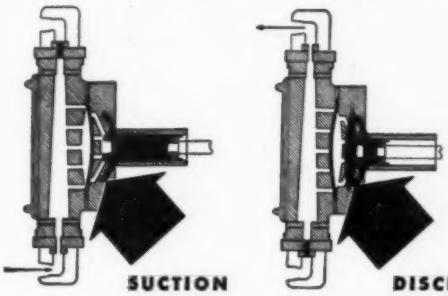
Fast as the work goes, you build for *permanence*. Flexible corrugated metal outlaws breakage. Corrosion is shackled by a full bituminous coating tightly bonded to the base metal. A thick bituminous pavement checks erosive action of sewage; makes the bottom last as long as the top.

Use ARMCO Asbestos-Bonded Sewer Pipe for essential repairs and include it in plans for new sewers. That way you build "for keeps"—provide your community with efficient, lasting, trouble-free sewerage. Our 48-page ARMCO Sewer Booklet will help you in your planning. Just write to Armco Drainage & Metal Products, Inc., and Associated Companies, 125 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO ASBESTOS-BONDED SEWER PIPE

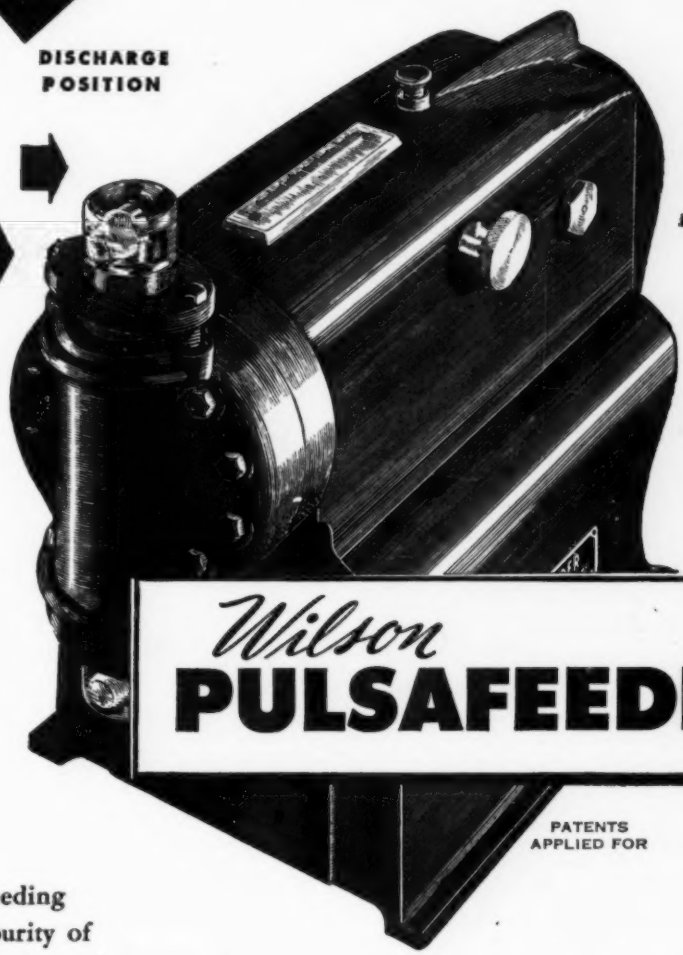
THE *Diaphragm* DOES IT!



SUCTION POSITION

DISCHARGE POSITION

The Wilson Pulsafeeder operates on the positive displacement principle of the horizontal reciprocating pump. The exclusive Pulsafeeder feature, however, is an hydraulically-balanced diaphragm which isolates the piston and cylinder from the chemical solution being pumped. No contamination of water supply by the pump; no corrosive attack on pump parts by chemical solutions.



★ **ISOLATES CHEMICAL SOLUTION FROM OPERATING PARTS**

★ **NO PACKING GLANDS**

★ **BALANCED HYDRAULIC PRESSURE**

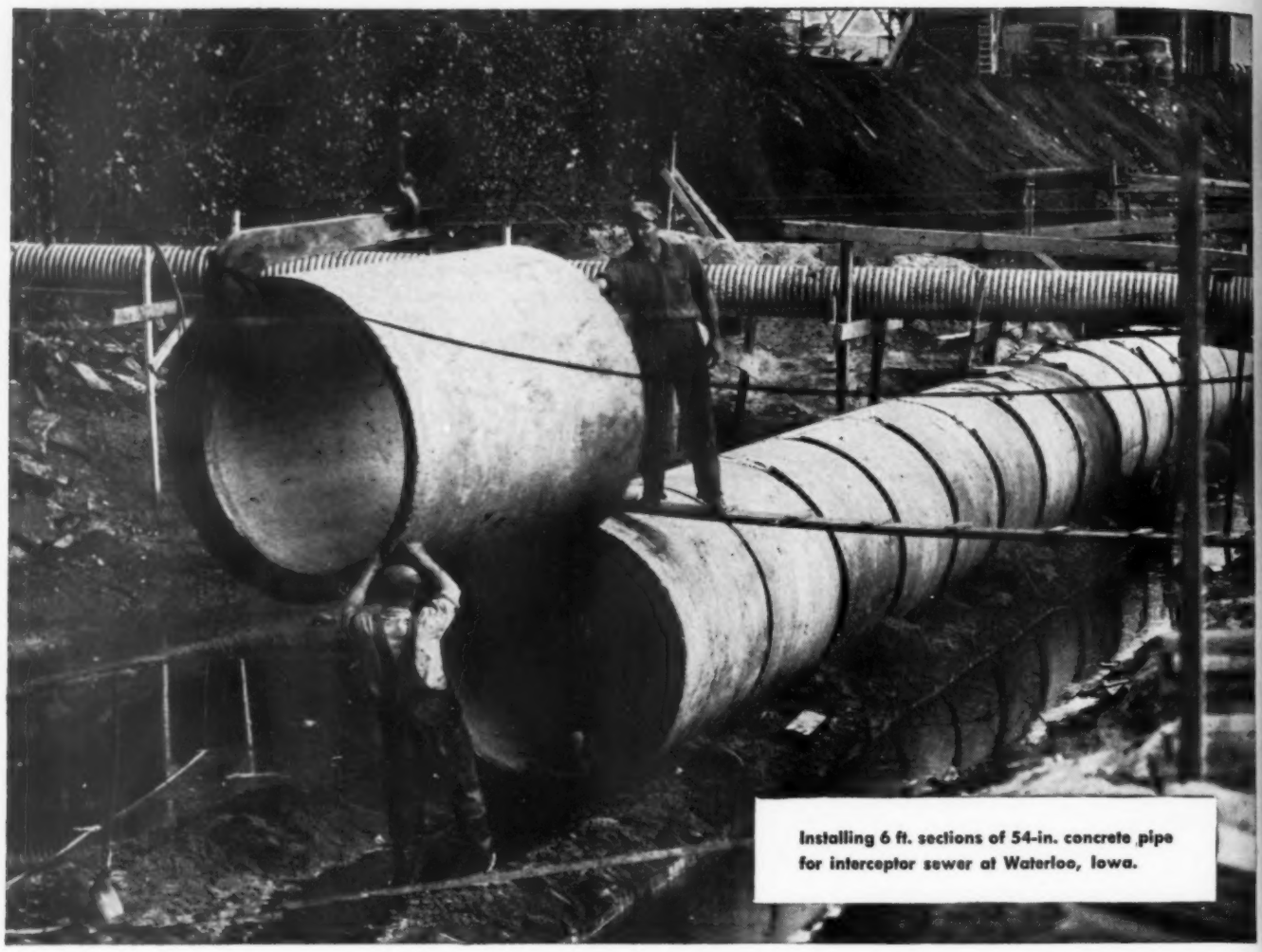
★ **POSITIVE DISPLACEMENT PISTON PRINCIPLE**

Wilson PULSAFEEDER

PATENTS APPLIED FOR

Long life of chemical feeding equipment and protected purity of your water supply is assured by the Wilson Pulsafeeder, the *balanced-diaphragm* Hypochlorinator and chemical feeder. Its rate of flow is continuously adjustable *while in operation.* Meter-controlled model maintains exactly proportioned feeding regardless of rate of water consumption. Sealed lubrication—all moving parts, except the motor, running in oil. Write for new illustrated description and specifications. *Process Equipment Division, Lapp Insulator Co., Inc., 114 Maple St., LeRoy, N. Y.*

Lapp



Installing 6 ft. sections of 54-in. concrete pipe for interceptor sewer at Waterloo, Iowa.

CONCRETE PIPE

Assures Long Service At Low Annual Cost

You can specify concrete pipe for drainage, sanitary sewers or water lines with perfect confidence because the efficiency and durability of concrete pipe lines under the hardest service, have been demonstrated in thousands of installations all over the country, many for more than half a century.

Concrete pipe has proved that it provides:

AMPLE STRENGTH to resist heavy loads and impacts.
MAXIMUM HYDRAULIC CAPACITY due to clean joints and smooth interior surface.
MINIMUM INFILTRATION AND LEAKAGE assured by tight joints and uniformly dense concrete.
HIGH WEAR RESISTANCE to abrasion from suspended grit.

These superior qualities plus the long life, moderate first cost and low maintenance expense of concrete pipe lines, assures *low annual cost*—the true measure of economy in pipe lines.

This Association or any of its members will gladly furnish technical information to assist in planning concrete pipe installations.

(List of our members on request.)

AMERICAN CONCRETE PIPE ASSOCIATION

228 N. LaSalle St., Chicago 1, Illinois — 342 Munsey Bldg., Washington 4, D. C.

BUY VICTORY BONDS

KEEP YOUR WATER SUPPLY *Safe* WITH DEPENDABLE UNIFORM

DIAMOND LIQUID CHLORINE

You can have complete confidence in the high quality of Diamond LIQUID CHLORINE. Made under closely-controlled manufacturing processes, it is dependable and pure. And regardless of the quantity you need, you can get Diamond LIQUID CHLORINE in convenient containers—individual cylinders, multi-unit cars or tank cars as required.

For complete satisfaction, standardize on DIAMOND. You will never regret your decision.

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PITTSBURGH 22, PA., AND EVERYWHERE

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Supply lines, deferred throughout the war years, are now a "must" in many communities. They represent a long term investment for taxpayers. The pipe used should have a known record of long life and low annual maintenance cost. It should be confidently expected not only to outlive the term of the bond issue, but to serve for generations after the bonds are retired. It will if it is U. S. Super-de Lavaud Cast iron pipe, centrifugally cast in sizes up to 24 inches, or U. S. Pit Cast pipe made in sizes up to 84 inches.

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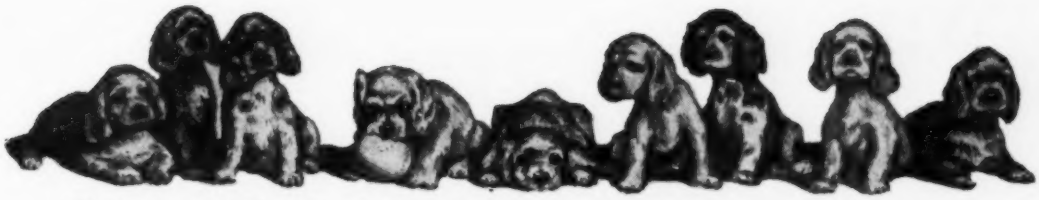
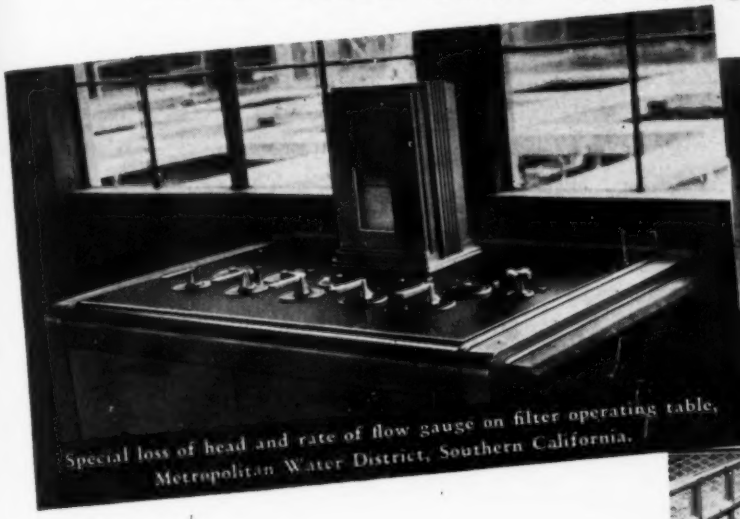
cast iron
PIPE

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Plants and Sales Offices throughout the U. S. A.



OF A LONG LINE OF THOROUGHBREDS



Special loss of head and rate of flow gauge on filter operating table, Metropolitan Water District, Southern California.

Operating Gallery, Zeolite Filters.

Equipment
WITH A BACKGROUND

Products of selective development, Builders Waterworks Equipment constitutes a distinguished "family."

One of the many notable waterworks with Builders Equipment is this modern filtration plant designed by Hoover & Montgomery, Engineers, for the Metropolitan Water District of Southern California. Specification of Builders Instruments for this and others of America's foremost waterworks reflects the high regard of leading engineers for Builders accuracy and reliability.

BUILDERS Water and Sewage Equipment

Venturi Tubes • Flow Nozzles • Flo-Watch • Type M Register-Indicator-Recorder • Filter Controllers • Wash Water Controllers • Filter Gauges • Chronoflo Telemeter—proportional dry or liquid control • Propeloflo Meter • Flo-Gage • Toledo Chronoflo-Conveyor Scale • Manometers.

For descriptive bulletins, address Builders-Providence, Inc., (Division of Builders Iron Foundry) 10 Codding Street, Providence 1, Rhode Island.

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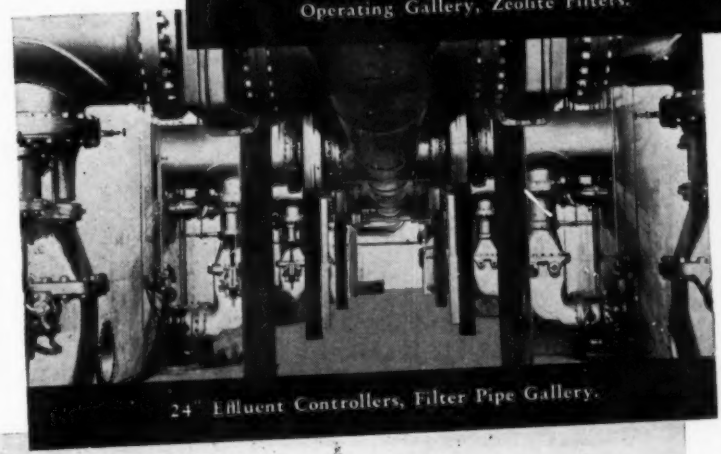
BUILDERS



24" Effluent Controllers, Filter Pipe Gallery.

Metropolitan Water District of Southern California Water Softening and Filtration Plant.

Photos courtesy Metropolitan Water District

Would you consider the testimony of 195 water works superintendents *important?* They report that the maintenance cost of cast iron distribution mains is far below that of other pipe materials. Would you value the experience of water supply systems in 200 of our largest cities? They report that some or all of their original cast iron mains are still functioning, after generations of service. There can be no doubt that the long life and well-nigh trouble-free service of cast iron pipe mean economy —*substantial* economy—in water works operation. Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, Peoples Gas Building, Chicago 3, Illinois.

CAST IRON

CAST IRON PIPE

SERVES FOR CENTURIES

150,000-gal. Horton Cylindrical-column Elevated Tank

—provides Pittsfield, Illinois, with an average of 200,000 gals. of water per day.

When normal city growth made an old 35,000-gal. elevated tank, 70 ft. to bottom, inadequate for supplying the necessary daily water requirements for the residents of Pittsfield, Illinois, it was replaced with the new Horton cylindrical-column elevated tank shown at the right. This new tank has a capacity of 150,000 gals. and easily supplies the necessary 200,000 gal. average daily consumption.

The water is taken from a lake located about two miles from the distribution system and pumped by 500 gpm-capacity, electrically-driven centrifugal pumps to the elevated tank which is located in the center of the city. Pumping pressure is not raised for serious fires.

Engineering Data Concerning the Pittsfield Water Distribution System.

- Length of distribution mains: 9 mi.
- Sizes of distribution mains: 4 in., 6 in., 8 in., and 10 in. diam.
- Length of transmission mains: 2 mi.
- Size of transmission mains: 10 in. diam.
- Kind of power used: Electric.
- Cost of power. 2 cents kwh.
- Number of fire hydrants in system: 76.
- Capacity of elevated storage tank: 150,000 gals.
- Average daily consumption: 200,000 gals.
- Number of customers supplied: 725.

CHICAGO BRIDGE & IRON COMPANY

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Los Angeles 14.....1455 Wm. Fox Bldg.
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WATER WORKS ENGINEERS

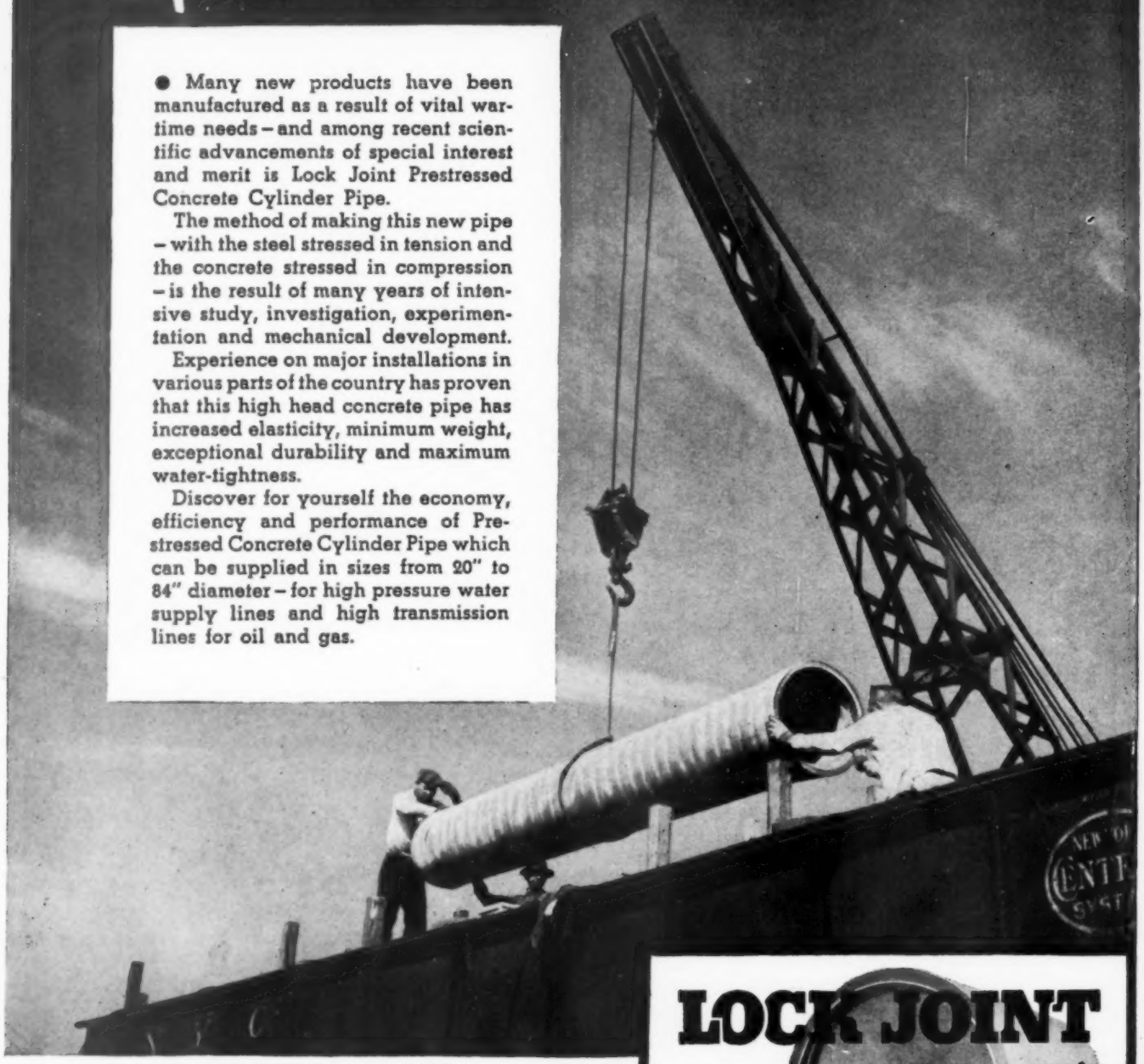
Specify prestressed concrete cylinder pipe on your next job

● Many new products have been manufactured as a result of vital wartime needs – and among recent scientific advancements of special interest and merit is Lock Joint Prestressed Concrete Cylinder Pipe.

The method of making this new pipe – with the steel stressed in tension and the concrete stressed in compression – is the result of many years of intensive study, investigation, experimentation and mechanical development.

Experience on major installations in various parts of the country has proven that this high head concrete pipe has increased elasticity, minimum weight, exceptional durability and maximum water-tightness.

Discover for yourself the economy, efficiency and performance of Prestressed Concrete Cylinder Pipe which can be supplied in sizes from 20" to 84" diameter – for high pressure water supply lines and high transmission lines for oil and gas.



LOCK JOINT PIPE COMPANY

Established 1905

P. O. BOX 269, EAST ORANGE, N. J.

Denver, Colo. · Chicago, Ill. · Kenilworth, N. J. · Kansas City, Mo. · Rock Island, Ill.
Joplin, Mo. · Valley Park, Mo. · Cleveland, Ohio · Hartford, Conn. · Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains in a wide range of diameters as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*

LOCK JOINT *Reinforced Concrete* **PRESSURE PIPE**

In every community the problem of supplying palatable water . . . free of objectionable tastes and odors is of prime importance. Waterworks officials in over 1,200 cities have used Aqua Nuchar Activated Carbon because they know it removes, by *adsorption*, those elements which cause unpalatable water. Water consumers are tough customers and they always demand that water be tasteless and odorless, regardless of season or condition.

An investment in Aqua Nuchar Activated Carbon pays big dividends! A survey of actual users has shown that the average cost of producing palatable water is only about two cents per capita per year.

Aqua Nuchar Activated Carbon is stocked at strategic points throughout the United States. Order a supply today and be prepared for emergencies.

INSURES PALATABLE NUCHAR DRINKING WATER

INDUSTRIAL CHEMICAL SALES

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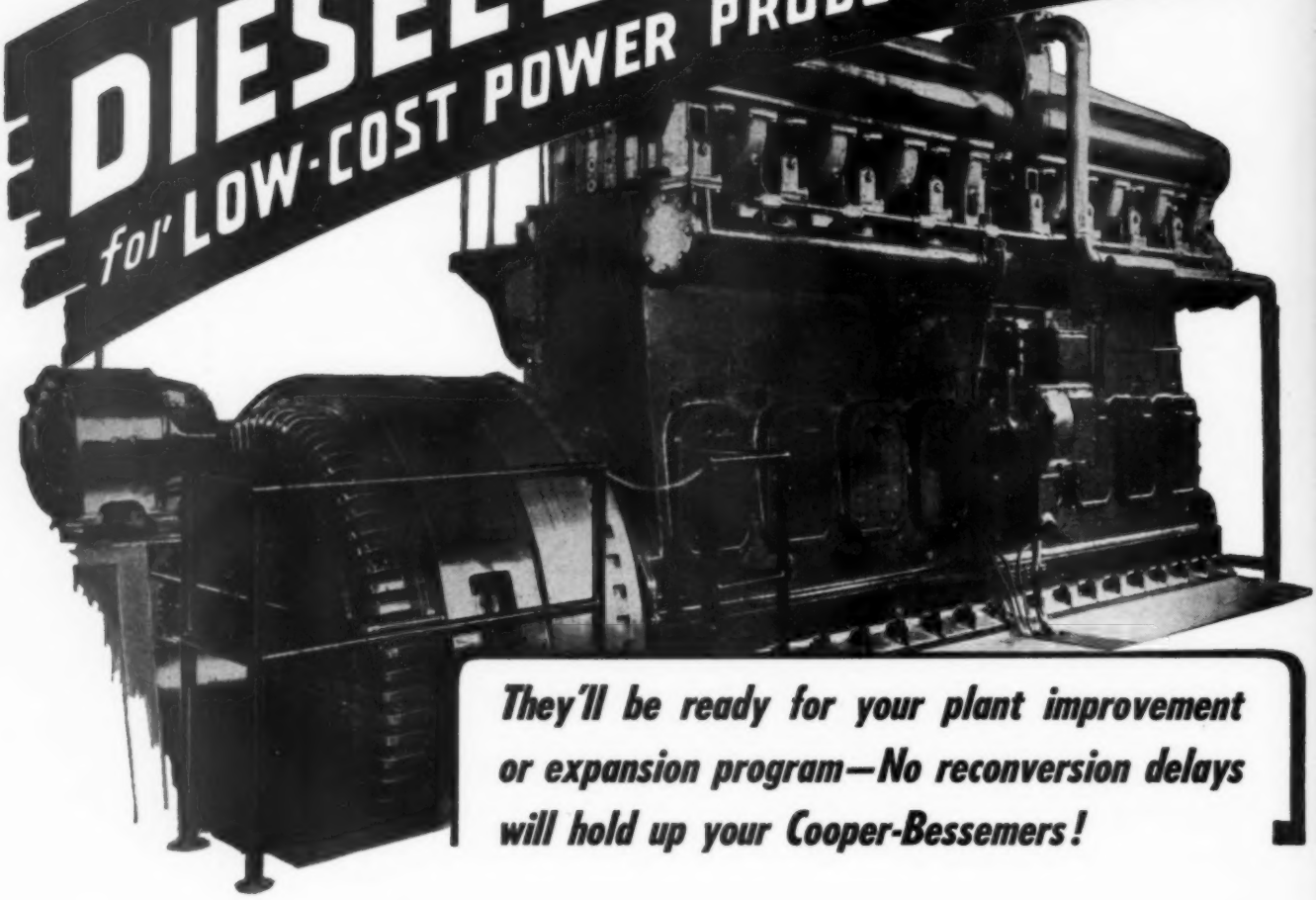
Order NOW

DIESEL ENGINES

for LOW-COST POWER PRODUCTION .....



They'll be ready for your plant improvement or expansion program—No reconversion delays will hold up your Cooper-Bessemers!

TODAY is the time to talk about your immediate and future power requirements—about diesel power.

In your business, there are power jobs that can be done expeditiously, economically by diesel—driving generators, or pumps, or blowers, or compressors. Now is the time to determine what you need, and take steps to get your engines earmarked for early delivery.

The same outstanding, reliable service that Cooper-Bessemer engines have always given can be yours during the years ahead. In fact, the engines you purchase today benefit from ten years' normal engineering development concentrated in two or three of war experience.

Cooper-Bessemer has diesel engines to sell today. Our plants have no reconversion problems. We are ready to serve private industry.

THE Cooper-Bessemer CORPORATION

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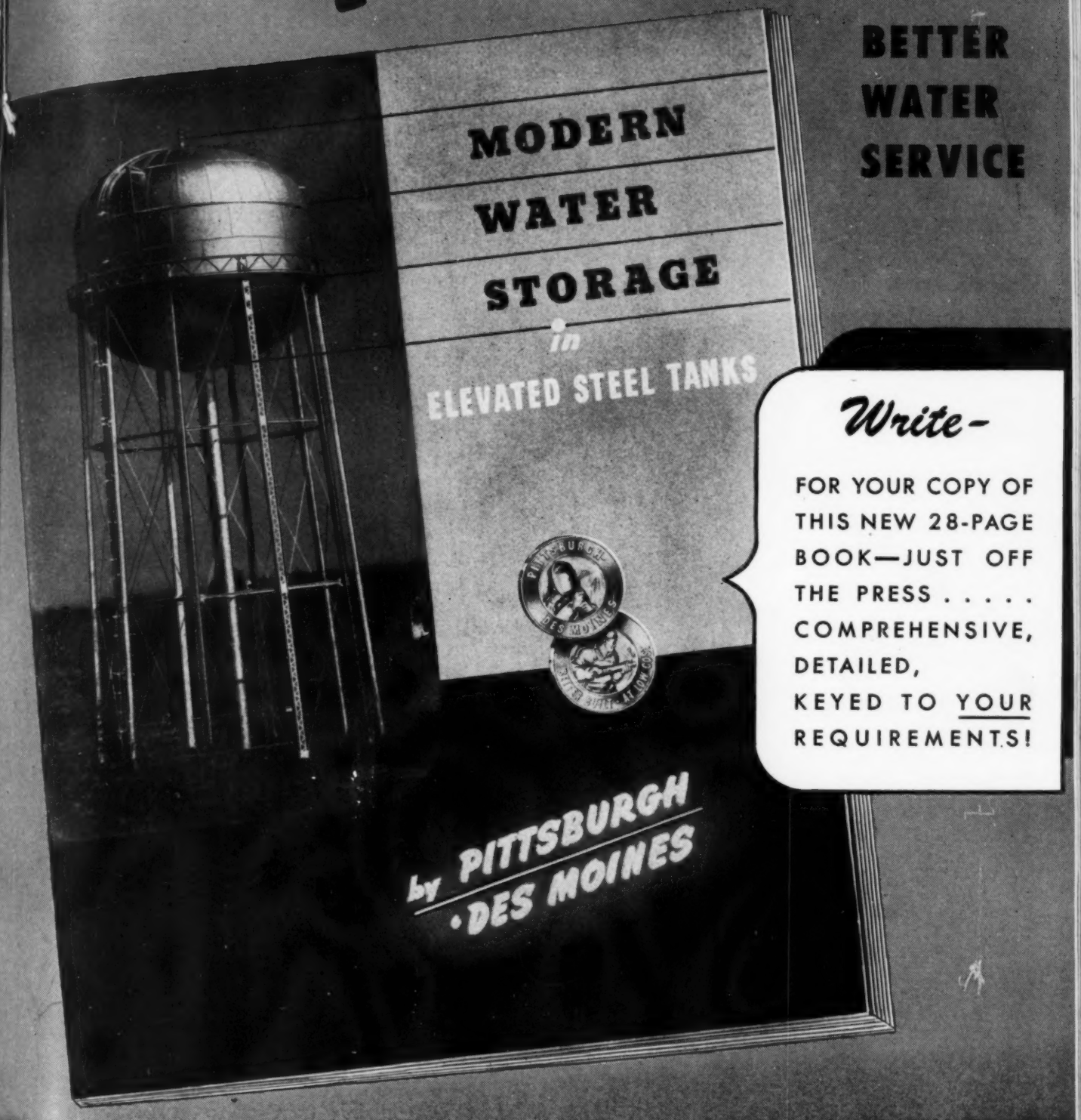
BUILDERS OF DEPENDABLE ENGINES FOR 112 YEARS

THE *Facts* you need— on BETTER WATER SERVICE



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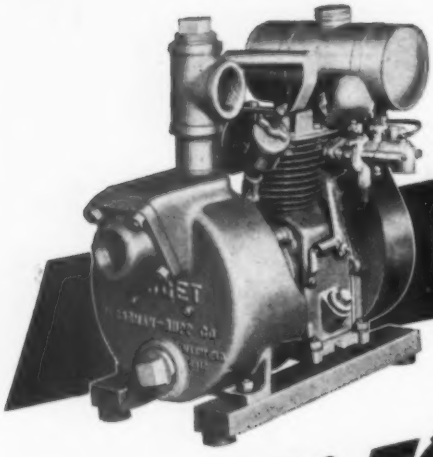


HANDY TO MOVE—

BRUTES FOR WORK—

EVERY GORMAN-RUPP IS "A LOT OF PUMP"

There's room on the smallest track speeder for a Gorman-Rupp pump that will put out 3,000 gallons per hour against a 20-foot head (The Midget). These can handle many small drainage jobs and get to and from the work quickly. For a little larger job there is the Eagle Model – with a weight of only 124 pounds it will pump 15,000 gallons per hour. This same kind of efficiency runs through the entire Gorman-Rupp line. For your big jobs there are heavy duty models up to 125,000 gallons per hour.

All Gorman-Rupps are completely self-priming. Start the engine and you start the water. They can't be clogged with any muck or solids that will pass the intake strainer. They will run months at a time without shut-down, if necessary. The unique Gorman-Rupp efficiency comes from the kind of streamlining that counts -- internal streamlining that speeds the flow of water.

There's a size of Gorman-Rupp self-priming centrifugal pump to meet the lightest or heaviest railroad needs but, regardless of size, they're all built to railroad requirements of durability.

THE MIDGET – 3,000 gallons per hour; 20-foot total head, 5-foot suction lift; length, 18½ inches, width, 9¾ inches, height, 15½ inches; weight, 60 pounds.

THE EAGLE – 15,000 gallons per hour (20-foot total head, 5-foot suction lift); length, 31½ inches; width, 20 inches; height, 22 inches; weight, 124 pounds.

MODEL 125-M – 126,000 gallons per hour (25-foot total head, 10-foot suction lift); length, 72 inches; width, 36 inches; height, 49 inches; weight, 2250 pounds;

GORMAN-RUPP PUMPS — UNSURPASSED FOR PUMPING FAST — ARMY NAVY

THE GORMAN-RUPP COMPANY

MANSFIELD . OHIO

FEDERAL TELEPHONE & RADIO FTR

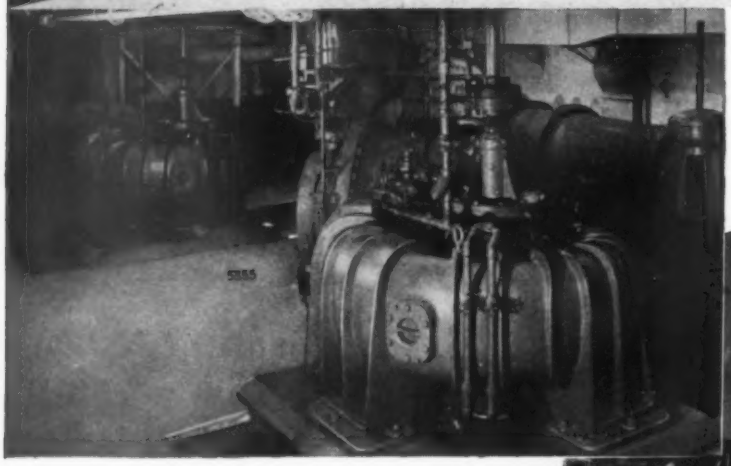
Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

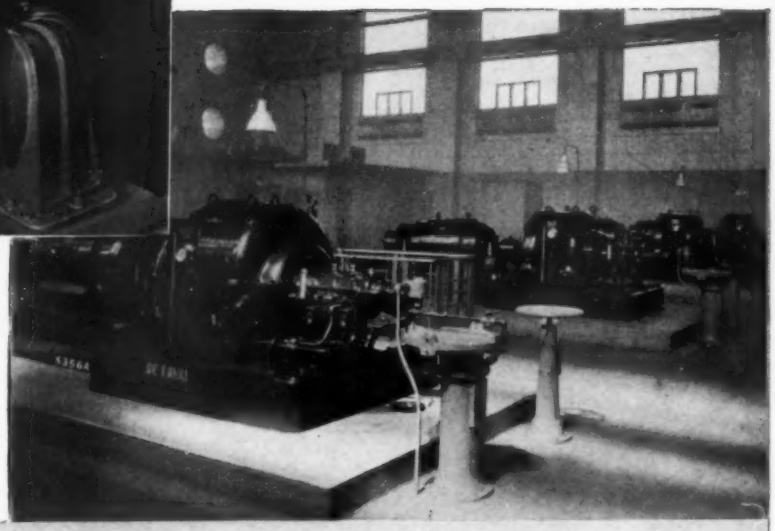
SEWAGE GASES GENERATE THE POWER

for DE LAVAL PUMPS and COMPRESSORS

in BOWERY BAY SEWAGE DISPOSAL PLANT



Two of a battery of four De Laval mixed-flow pumps at Bowery Bay. Each of the 36" pumps delivers 29,480 g.p.m. against 40 ft. head.



Four De Laval compressors at Bowery Bay, each of which delivers 10,000 c.f.m. against 7¾ psi. These compressors are directly connected to high-speed 3500 r.p.m. slipring motors.

All pumping in the modern 60 m.g.d. Bowery Bay Sewage Disposal Plant, serving the City of Brooklyn, is handled by De Laval mixed-flow centrifugal pumps; and all air required by the activation chambers is delivered by De Laval compressors.

Approximately half of the power needed to drive these units is furnished by generators driven by gas engines receiving fuel in the form of gas from the digestion chambers.

Bowery Bay is one of many sewage disposal plants served by De Laval pumps and compressors.

3234

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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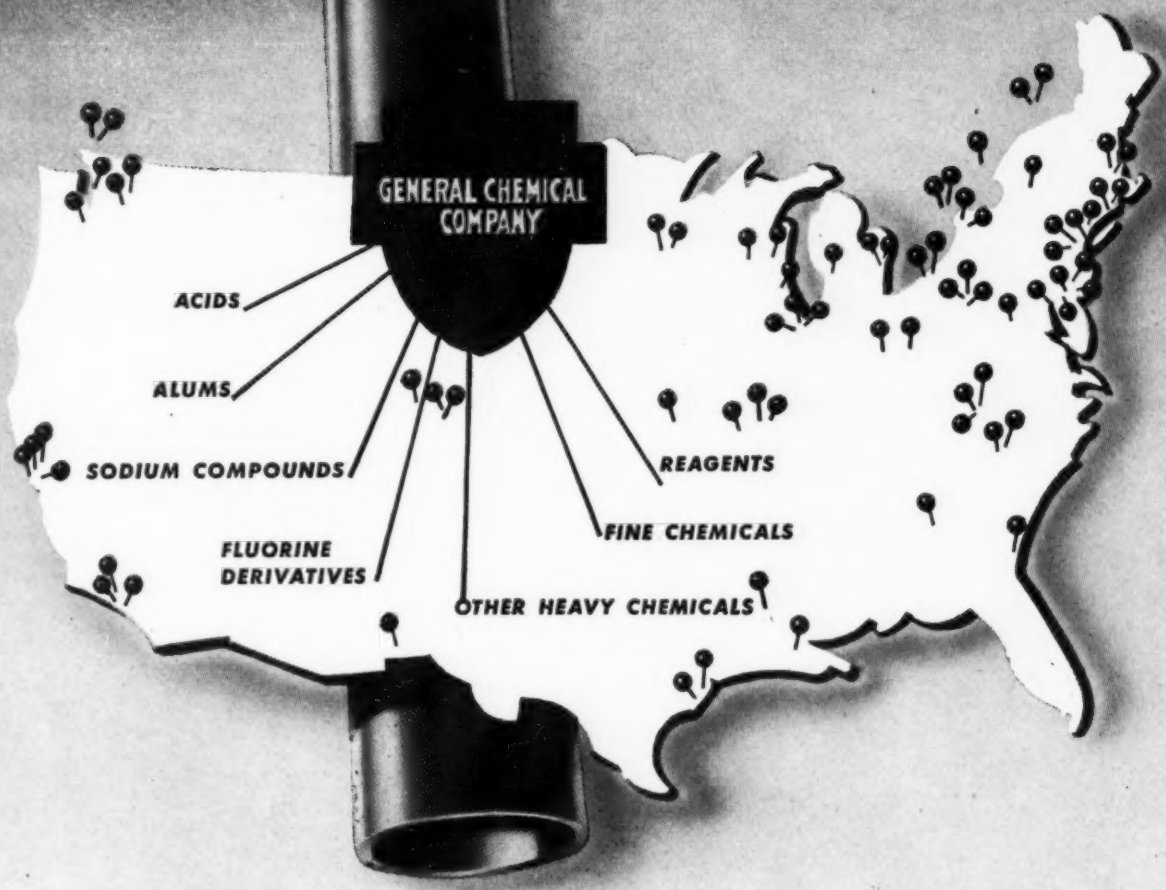
Supply Line for American Industry...



Here is the supply line of Basic Chemicals for American Industry. North, South, East or West . . . wherever the needs are greatest . . . there, too, are the heaviest concentrations of General Chemical *plants, warehouses,* and *technical service offices*—equipped and prepared to meet the chemical demands of the day.

For almost half a century, this supply line has grown ever stronger. It spans the continent . . . reaches out to the most remote locations . . . always maintaining the full flow of a broad and varied range of chemicals so necessary to peak production.

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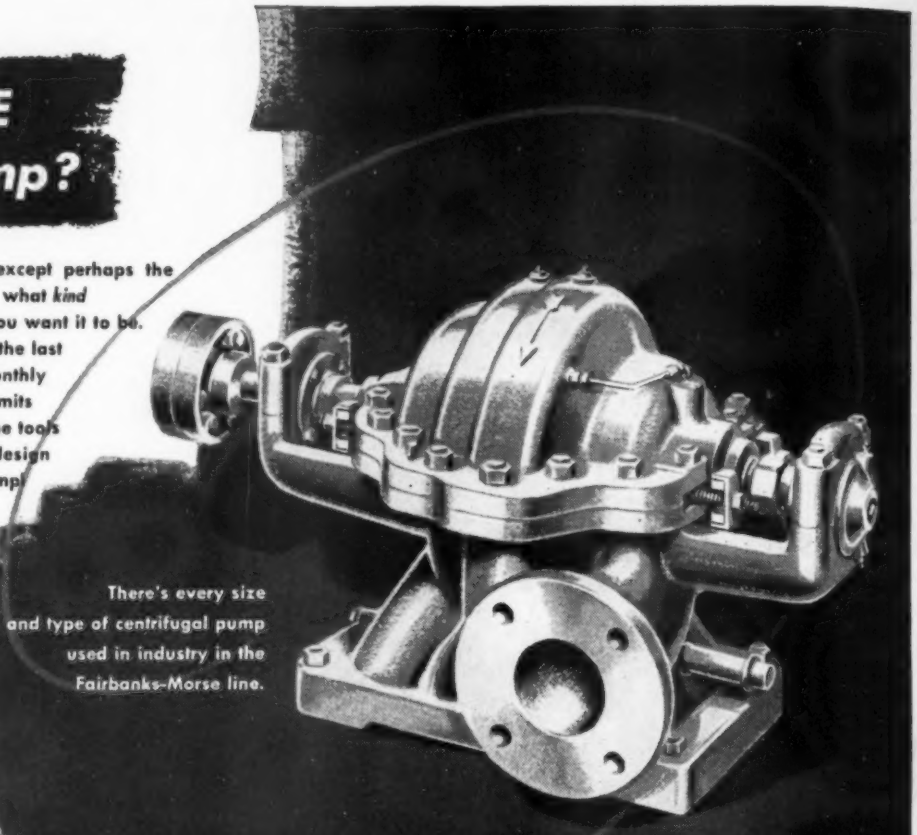
Can ANYONE make a Pump?

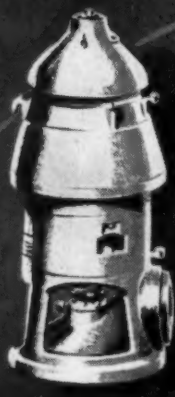
Well, there's no law against it—except perhaps the "law of survival." It's a question of what *kind* of pump you want—and how *good* you want it to be. If you want a pump that will squeeze the last fraction of a cent in value out of the monthly power bill, that is designed to the very limits of hydraulic knowledge—built with the fine tools and complete facilities that such precision design requires—you'll want a Fairbanks-Morse pump!



There's every size and type of centrifugal pump used in industry in the Fairbanks-Morse line.

WHEN YOU BUY a Fairbanks-Morse, Pomona or Westco pump, you get a design which is the result of accumulated years of research in not only our own laboratories but those of the universities' scientists whom we have retained.

Westco pumps: precision-built, broad in application.



For all vertical turbine pump work—the Pomona line.

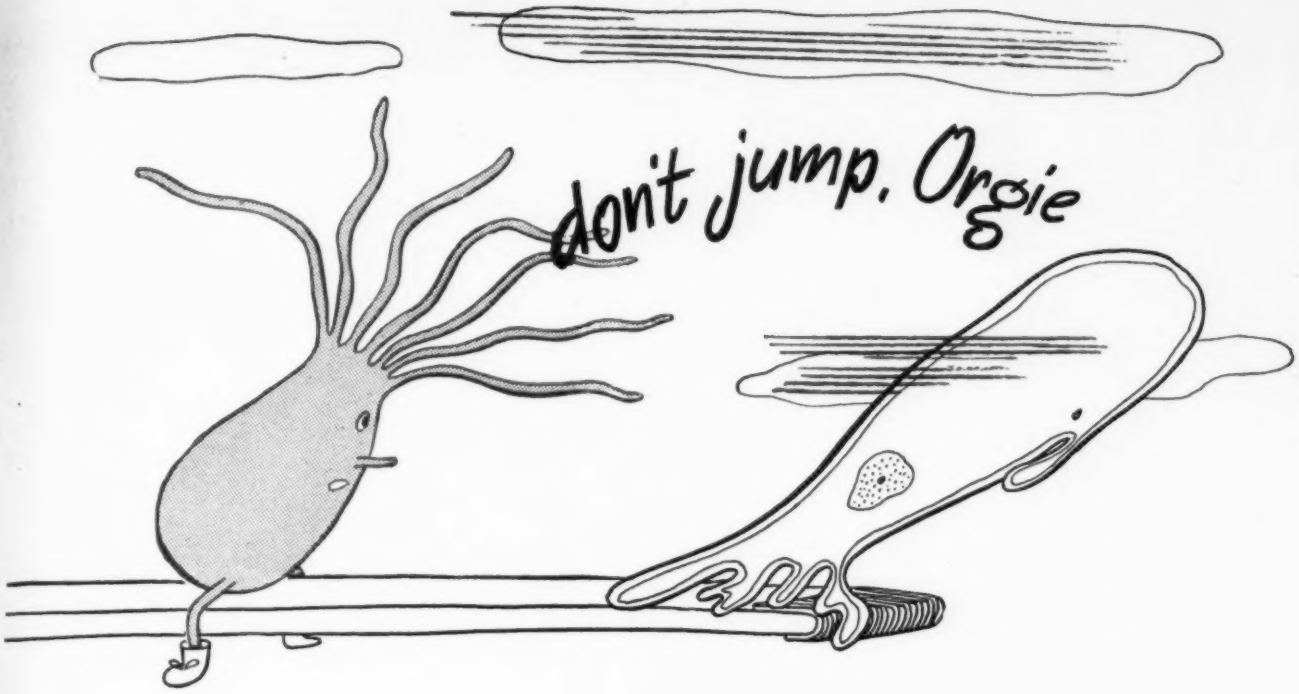
THIS DESIGN and unlimited manufacturing facilities, which only the largest pump manufacturers can offer you, combine to give you pumps superior in performance and reliability.

ANYONE CAN MAKE A PUMP—perhaps! But for *proved* value, *skilled* service—regardless of the type of pumping requirements or the amount of liquid to be moved—Fairbanks-Morse is an unquestioned leader. Call your nearest Fairbanks-Morse distributor or branch office.

FAIRBANKS-MORSE

A NAME WORTH REMEMBERING

PUMP DIVISION



that water's been treated with

PITTCHLOR

Pittchlor's minimum of 70% available chlorine is sure death to most harmful microorganisms, bacteria and algae. This high-test calcium hypochlorite is excellent for chlorination of water supplies . . . for the treatment of sewage . . . and for many other disinfection, deodorant and general sanitation tasks.

Easy and economical to use—packed in 5 lb. resealable cans (9 to the case) and 100 lb. drums. Carried in stock by leading jobbers.

COLUMBIA CHEMICALS

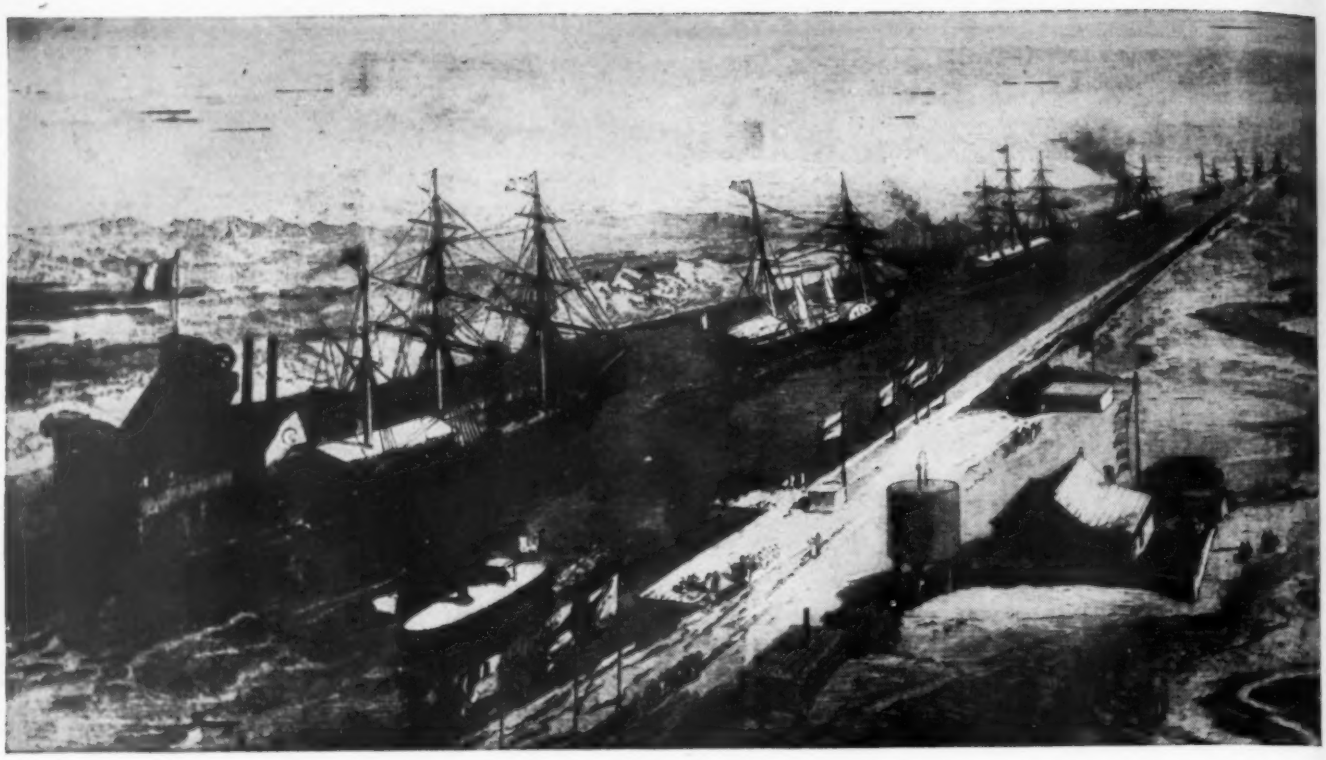
PITTSBURGH PLATE GLASS COMPANY • COLUMBIA CHEMICAL DIVISION

GRANT BUILDING, PITTSBURGH 19, PENNSYLVANIA • Chicago • Boston • St. Louis • Pittsburgh

New York • Cincinnati • Cleveland • Philadelphia • Minneapolis • Charlotte • San Francisco

COLUMBIA ESSENTIAL INDUSTRIAL CHEMICALS

Soda Ash • Caustic Soda • Liquid Chlorine • Sodium Bicarbonate • Pittchlor • Silene EF (Hydrated Calcium Silicate) • Calcium Chloride • Soda Briquettes • Modified Sodas • Caustic Ash • Phosflake • Calcene T (Precipitated Calcium Carbonate)



Famous Facts

Five or six hundred years B.C., water-borne traffic from the Mediterranean reached the Red Sea by way of a canal at the site of the present Suez Canal. It fell into disrepair, was restored, again fell into disuse, and was restored again in 640 A.D. In 1859, the plans of Ferdinand de Lesseps were followed for the construction of the present Suez Canal at a cost of over 130 million dollars. It is a sea-level canal, without locks, running some 100 miles between Port Said on the Mediterranean and Port Twefik, south of Suez, Egypt, across the Isthmus of Suez. The first ships sailed through the new canal in 1869. Today, the annual tonnage amounts to over 30 million tons.

By the time the Suez Canal was finished, Bitumastic Enamel, the first product of its kind, was winning acclaim as a protective coating for underground and underwater surfaces.

Today it is giving maximum, long-time corrosion protection to water works and sewer pipe lines in every type of corrosive soil and climate. Another Bitumastic product, Bitumastic No. 50, a unique, thick, coal-tar base coating, also gives lasting protection against corrosion to prolong the life of sewage structures and equipment.

WAILES DOVE-HERMISTON

CORPORATION

WESTFIELD, NEW JERSEY

New York 4 • Philadelphia 8 • Cleveland 14 • Chicago 3 • Houston 2
Tulsa 3 • Miami 36 • San Francisco 10 • Los Angeles 2

TWO "YARDSTICKS" FOR MEASURING WATCH DOG WATER METERS

WATCH DOG
WATER METERS

1. Who Makes Them?
2. Who Uses Them?

1. Made by Worthington-Gamon. When you specify Watch Dog Water Meters you get the design and performance advantages that result from the know-how of the oldest water meter manufacturer in the business . . . backed by the largest research and production facilities in the field of hydraulics. You also get the service offered by 24 district offices in 24 leading cities.

2. Used by thousands of municipalities and private water companies in the United States and abroad. It stands to reason that the meter that is first choice can also meet your specifications for accuracy, low maintenance, long life. Investigate Watch Dogs.

WORTHINGTON-GAMON METER COMPANY
282-296 SOUTH STREET
NEWARK, NEW JERSEY
Subsidiary of
WORTHINGTON
PUMP AND MACHINERY CORPORATION

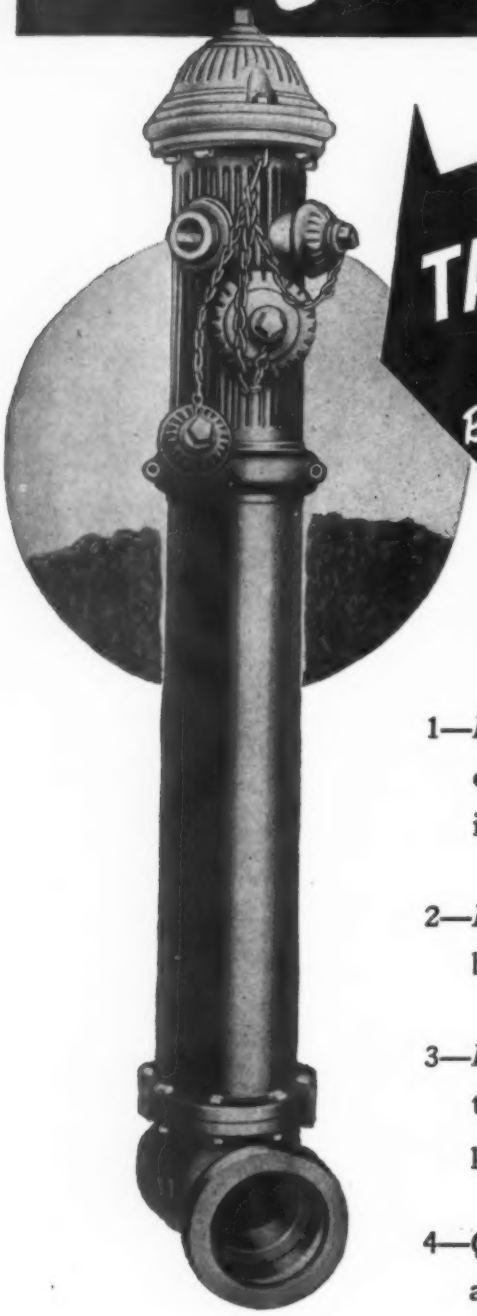
G5.5

The Meter Specified in the Largest Contracts Ever Awarded in the U. S.

WATCH DOG WATER METERS

"Watch Dog" models... made in standard capacities from 20 G.P.M. up; frost-proof or split case in household sizes. Disc type, Turbine type or Compound type. Write for Bulletin.

FROST CAN'T BUDGE A SMITH HYDRANT



THE TAPERED BARREL BREAKS THE GRIP

The tapered barrel of the SMITH Protectop Hydrant prevents frost-swollen ground from gripping the barrel, heaving it upward, dislocating the hydrant, and straining the connections. As the earth rises with expansion, it slides upward along the narrowing taper of the barrel, releasing the grip.

Only SMITH *has all of these* FEATURES

1—*Positive action drain;* always closed when the main valve is open, opening, or even partially open. When the main valve is closed the drain is always open.

2—*Low friction loss.* Barrel cross-section exceeds valve area by 200%.

3—*Protectop breakable coupling.* Patented coupling construction confines breakage to quickly and inexpensively renewed parts.

4—*Quick accessibility.* All working parts are easily removed and replaced, without excavation.

FIRE HYDRANTS
GATE VALVES
CHECK VALVES
INSERTING VALVES
TAPPING SLEEVES AND VALVES
WATER SERVICE BRASS GOODS

THE A. P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

FLOOR STANDS
INDICATOR POSTS
TAPPING MACHINES
INSERTING MACHINES
PIPE CUTTING MACHINES
CORPORATION TAPPING MACHINES

HERE ARE ALL THE FACTS ABOUT THE

SIMPLEX TYPE MO METER

The High-Accuracy Flow Rate Meter

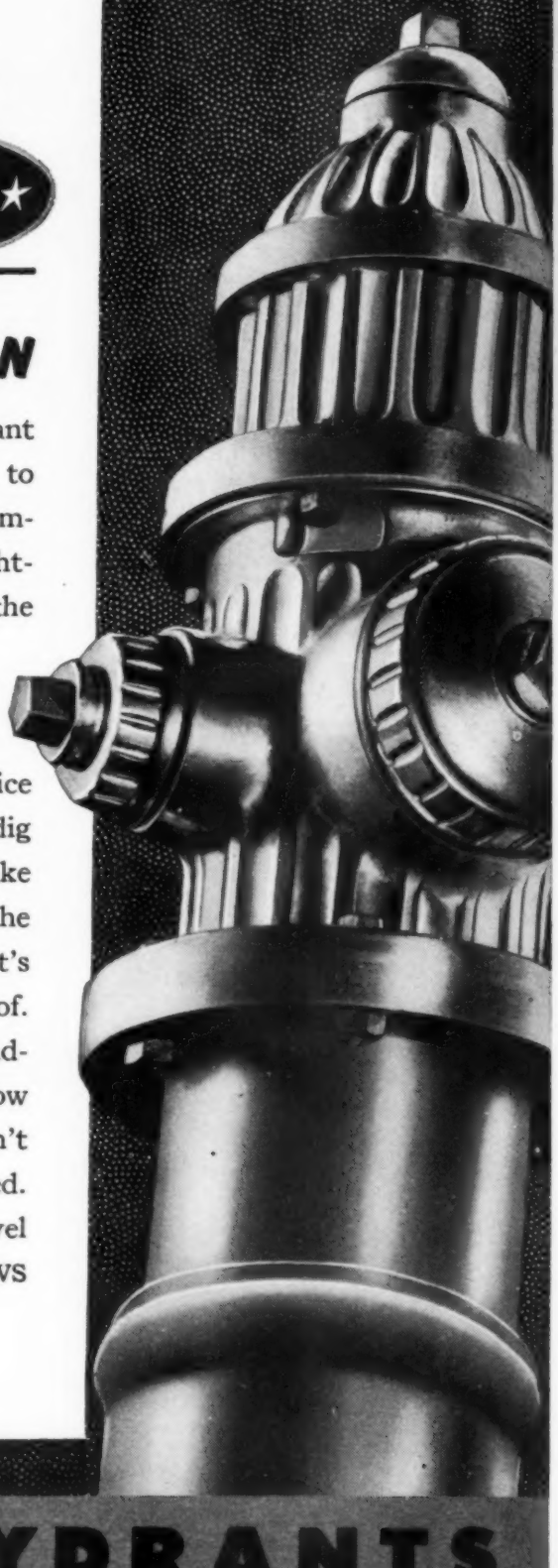
Write today for your copy of Bulletin 300 which details the operation, use, specifications, and accuracy of the Simplex MO flow rate meter. Specified by operating men and management from coast to coast.

SIMPLEX VALVE & METER COMPANY

6743 UPLAND STREET, PHILADELPHIA 42, PA.

ONCE IN A BLUE MOON

Once in a blue moon even a MATHEWS hydrant may need repairs. When it does, restoring it to service is like putting a flashlight back in commission: You slip a spare cell into the flashlight-case; you slip a spare barrel (containing the working-parts) into the hydrant-case. This quick repair means better protection of property and much less of a maintenance problem. There is no prolonged out-of-service time while you break the pavement and dig down through frost-hardened ground. You take the damaged barrel back to the shop, repair the mechanism, and it becomes the next spare. That's economy! MATHEWS are virtually trouble-proof. The operating-thread is kept dry, rust-free, sand-free and can be oiled from the outside; the low orifice drains out all the water . . . frost can't form. Every friction-point is bronze-protected. The head rotates a full circle, the nozzle-level can be raised or lowered. No wonder MATHEWS have led the world for over 75 years!



MATHEWS HYDRANTS

Made by **R. D. WOOD** *Company*

PUBLIC LEDGER BUILDING
INDEPENDENCE SQUARE, PHILADELPHIA 5, PA.

MANUFACTURERS OF SAND SPUN PIPE (CENTRIFUGALLY CAST IN SAND MOLDS) AND R. D. WOOD GATE VALVES

The progressive city of DUQUOIN states some facts

In operation since June 30, 1944, the city of Duquoin, Ill., has had ample time to consider their experience with ALOXITE aluminum oxide porous underdrain plates in a ½ MGD filter. What's more they have two other filters (same size), with graded gravel support, to use for comparison.

They now desire to get ALOXITE plates for these two filters also, for superior performance has resulted from ALOXITE plates, *with uniform backwash over the entire bed.* What's more there is a considerable saving in filtered water because backwashing only requires one-third as long as in the other two units. Nor is there any need for worry over the displacement of graded gravel.

Since improved conditions are maintained in the filter equipped with the ALOXITE plates there has been a comparative reduction in bacterial count. The report concludes with the statement that "we wish we had ALOXITE porous underdrain plates in the other two filters".

The experience of the city of Duquoin adds another impressive chapter to the history of ALOXITE plates. Our technical service is at your disposal, at any time, to discuss the features and operation of all porous products by CARBORUNDUM. Write Dept. O-16, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.

Underdrain Plates

BY CARBORUNDUM

TRADE MARK

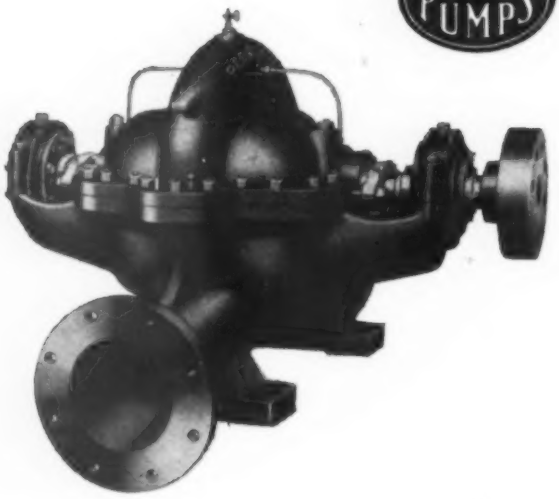
"Carborundum" and "Aloxite" are registered trademarks of, and indicate manufacture by, The Carborundum Company

Continuous Duty

HORIZONTAL PUMPS

One of a battery of three Peerless Horizontal Pumps, Type CSLH, 48, producing 70,000 gallons per minute, operated by Briscoe Water Company, Angleton, Texas.

PEERLESS PUMPS



TYPE A PUMP
Single Stage, Double Suction, twin pumping set driven by a single motor.

Precision-built by Peerless

Peerless (formerly Dayton-Dowd) Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating costs are desired. Engineered and manufactured with a view to long life, Peerless Pumps are available for all classes of pumping requirements.

HORIZONTAL PUMPS FOR:	VERTICAL PUMP TYPES:
Water Towers	Deep Well Turbine
Boosters	Hi-Lift (Moyno Type)
Fire Protection	Centrifugal
Boiler Feed	Sewage
Condensate	Jet
Sewage	Shallow Well
Chemicals	Hydro-Foil (propeller)

The right pump for the right job. All inquiries and specifications processed by trained engineers.

Ask for name of Distributor nearest you.

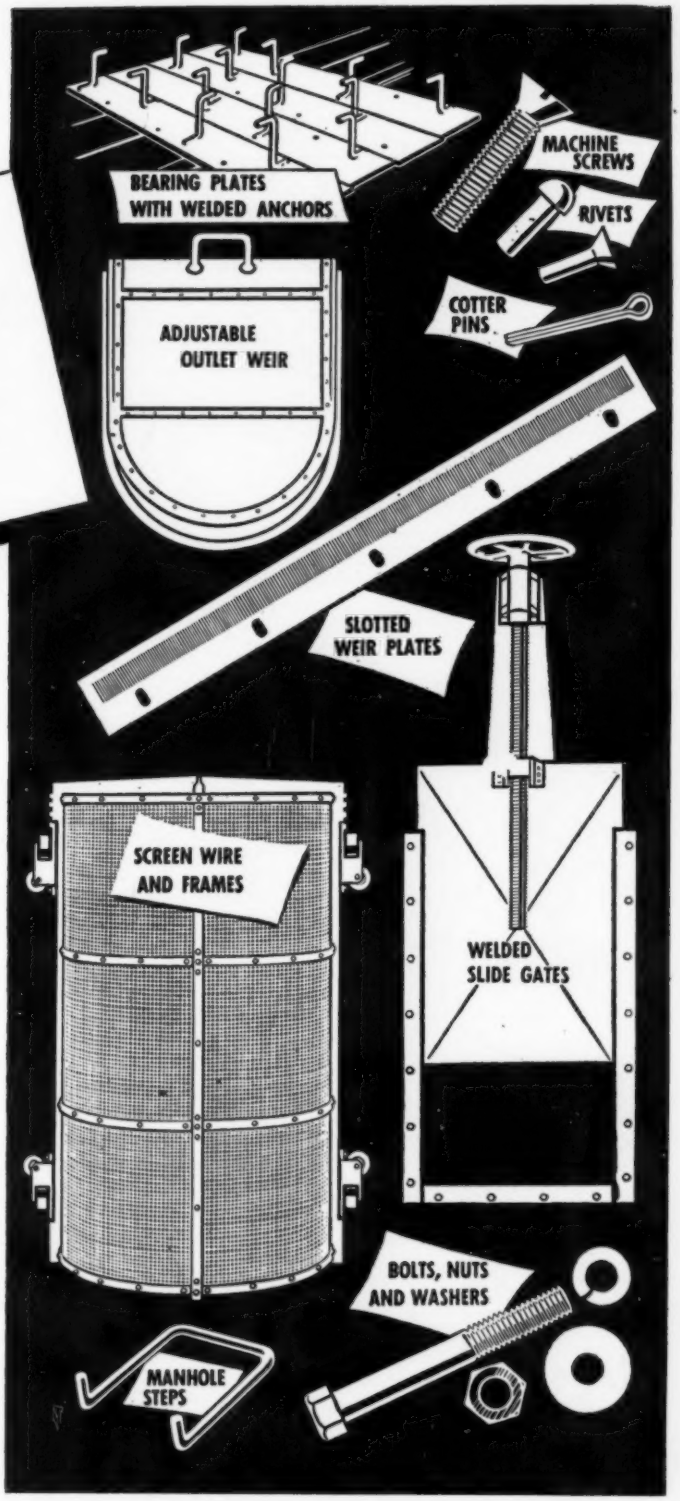
PEERLESS PUMPS

PEERLESS PUMP DIVISION - FOOD MACHINERY CORPORATION

FACTORIES

Los Angeles 31, Calif. • Quincy, Ill. • Canton 6, Ohio

For Parts like these ... use **EVERDUR**



It will pay you for these 4 reasons:

1 Everdur* Copper-Silicon Alloy combines the corrosion resistance of copper with the tensile strength of mild steel, and thus provides trouble-free, economical service under severely corrosive conditions.

2 Everdur makes possible lightweight, built-up construction without sacrificing durability.

3 Everdur is available in practically all commercial shapes and can be readily fabricated and welded.

4 Everdur offers a *proven record* in Sewage and Water Works service...18-year-old installations are still in excellent condition.

For detailed information, write for Publications E-11 and E-6.

*Reg. U. S. Pat. Off. 45139

EVERDUR is also widely used for:

Coarse and Fine Screens, Float Chambers, Swing Gates, Built-up Sluice Gates, Coarse Bar Rack Aprons, Effluent Weirs and Scum Weirs, Structural Scum Baffle Brackets, Troughs, Screen Hoppers, Orifices, Baskets, Pipe, Ladders, Float Gage Chains, Valve Springs, Guides, Walkways, Electrical Conduit, Flashboard Supports, Flush Box Fittings, Spillway Fittings, Valve Stems.

ANACONDA *Everdur Copper-Silicon Alloy*

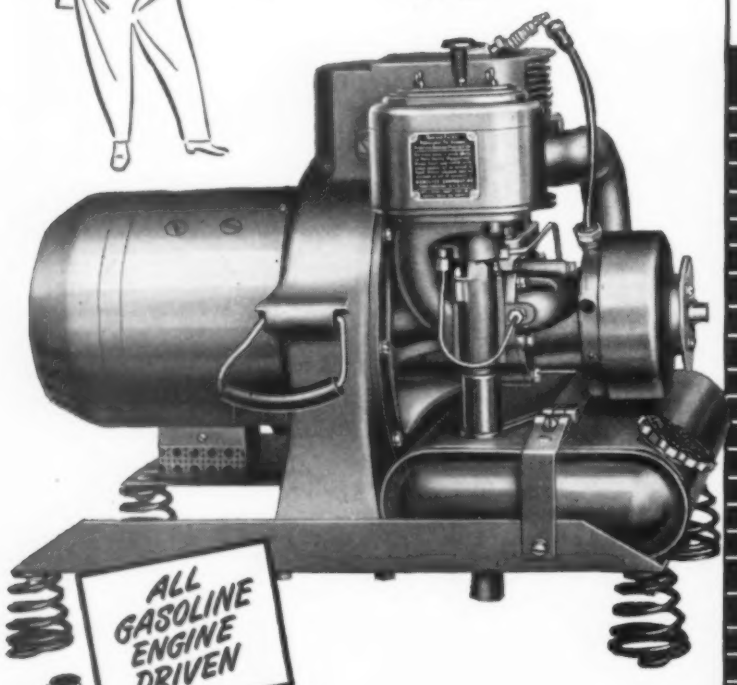
THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

The Largest Line of HOMELITE GENERATORS Ever Offered...

ALL NEW...

ALL PORTABLE



ALL GASOLINE ENGINE DRIVEN

STANDARD MODELS NOW AVAILABLE

(Special units built to meet your requirements)

GENERATOR MODELS	VOLTS	AMPS.	WATTS UNITY PF
DC Compound Wound			
22D120	120	6.2	750
23D120	120	12.5	1500
21D120	120	16.7	2000
24D120	120	20.8	2500
25D120	120	33.4	4000
AC MODELS			
60 Cycle Single Phase			
22A115	115	4.3	500
23A115-11	115	8.7	1000
23A115-1	115	13	1500
21A115	115	15.6	1800
24A115	115	21.7	2500
25A115	115	34.8	4000
24A115/230	115/230	10.9	2500
25A115/230	115/230	17.4	4000
DC MODELS—Shunt Wound			
23D30	22-30	50	1500
24D30	22-30	83.3	2500
22D60	42-60	12.5	750
23D60	42-60	25	1500
21D60	42-60	33.3	2000
24D60	42-60	41.7	2500
25D60	42-60	66.7	4000
22D160	130-160	4.7	750
23D160	130-160	9.4	1500
21D160	130-160	12.5	2000
24D160	130-160	15.6	2500
25D160	130-160	25	4000
AC — 60 Cycle 3 Phase			
24A230	230	6.3	2500
25A230	230	10.0	4000
AC — 180 Cycle 3 Phase			
24AH230	230	6.3	2500
25AH230	230	10.0	4000

SEE WHAT THEY CAN DO FOR YOU

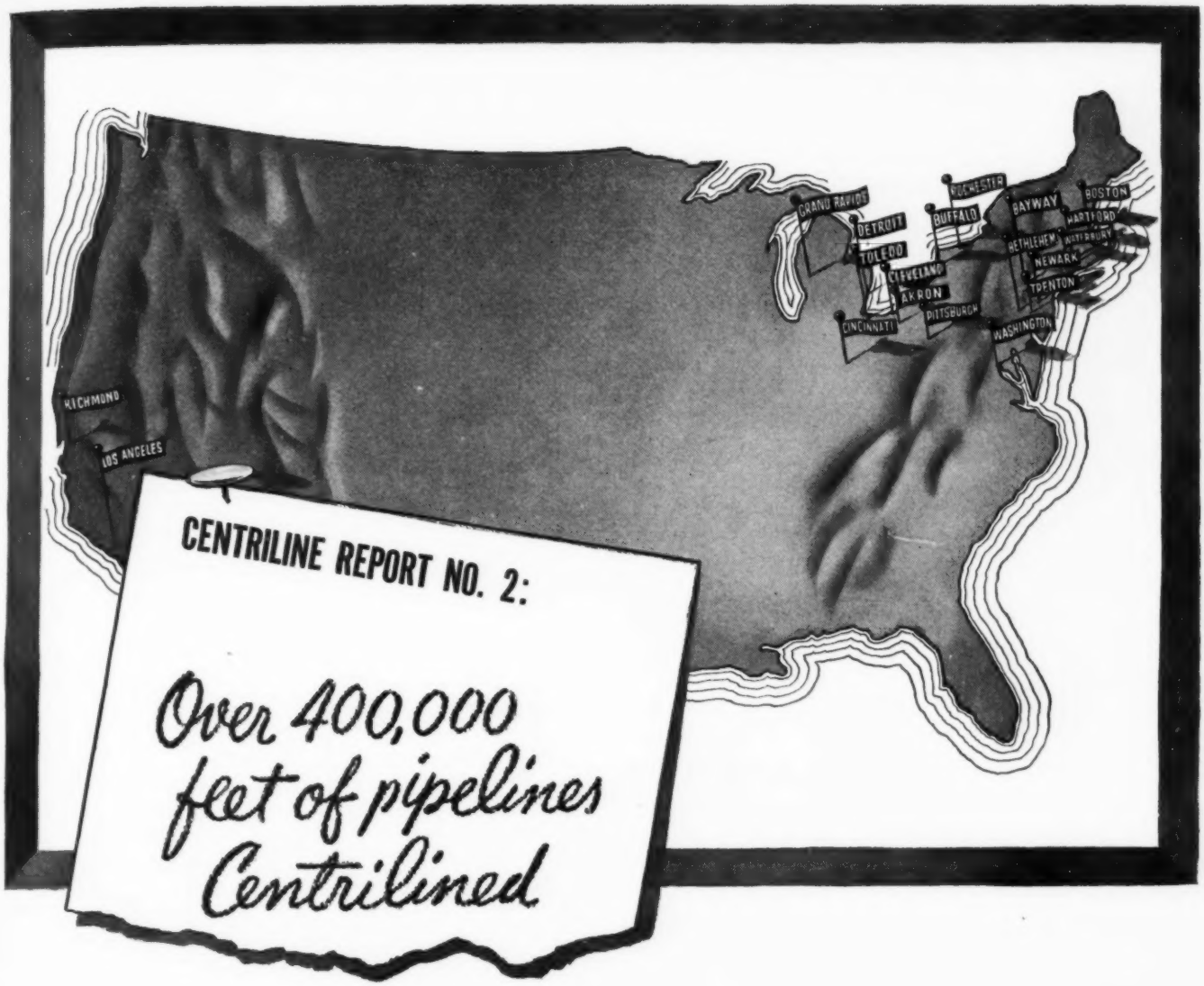
Send for Bulletin L-406 or better yet, arrange for a demonstration. The Homelite representative in your territory will gladly show you how Homelite Generators can be used for operating floodlights, power tools, or any electrical equipment, or for standby service to maintain lighting, communications, or similar services. Write today. No obligation.

HOMELITE

CORPORATION

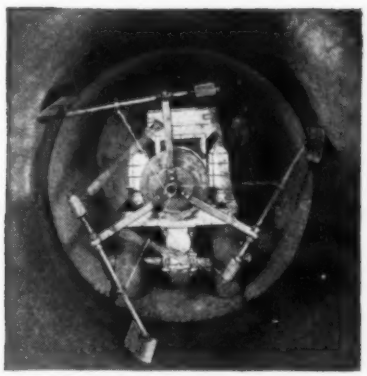
Portable PUMPS • GENERATORS • BLOWERS

PORT CHESTER, NEW YORK



NINETEEN major cities throughout the United States . . . from New York to California . . . now have higher carrying capacity in their important water supply lines—as a result of the Centriline process of reconditioning 29 installations—totaling almost a half-million feet of age-old pipelines.

Through the Centriline method of first cleaning the main and then applying by centrifugal force a thin protective inner lining of cement mortar the original carrying capacity of these important pipelines was restored. Not only was there an increase in the amount of water delivered, but also depreciation and pumping costs were cut to a minimum.



The Centriline process is a rapid and economical method of reconditioning pipelines. It consists of first cleaning the main, then applying by centrifugal force, a dense cement mortar lining of required thickness, mechanically troweled to a smooth finish. This is done underground, in place.

If tuberculation has invaded your water system lines—it's high time to CENTRILINE . . . and eliminate future depreciation costs and pumping expenditures. Wherever your pipeline is situated—whatever its length—if its diameter is 30" or more—Centriline men and Centriline equipment can quickly reach and recondition it.

CENTRILINE PROCESS

CENTRILINE CORPORATION

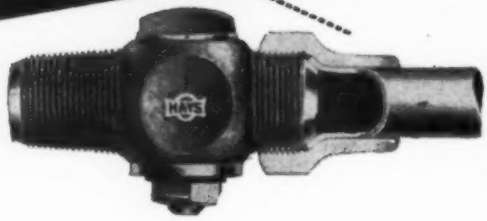
146 CEDAR STREET • NEW YORK 6, N. Y.

Restores and Protects Pipe-Line Carrying Capacity

SEVENTY-SIX YEARS HAYS DEPENDABLE SERVICE

COPPER SERVICE METHOD

Assures { SIMPLICITY SAFETY ECONOMY



1-Accepted Water Works Standard Threading Permits Use in Any Standard Tapping Machine

2-Interchangeable With All Other Makes

HAYS, a pioneer in the development of copper pipe services, has a complete line of stops and fittings for use with copper pipe. The use of copper pipe and Hays Radius Seal Joints eliminates much labor in installation. It simplifies the making of tight, leak-proof connections which, together with its long functional life, provides the utmost in economy

Illustration shows a Hays Corporation Stop with Hays Radius Seal Joint. This popular joint features a 45° machined seat and pipe flare and is available directly on Hays Corporation and Curb Stops, Service Connections, Goosenecks, Branches, Adapters, Stops and Drains, etc. Each Hays fitting is hydrostatically tested at 200 pounds or more; is uniformly accurate in every dimension. Hays Water Service Brass Goods Catalog shows illustrations and gives full descriptions. Send for your copy

BE SURE TO REPLACE WITH ANOTHER HAYS STOP

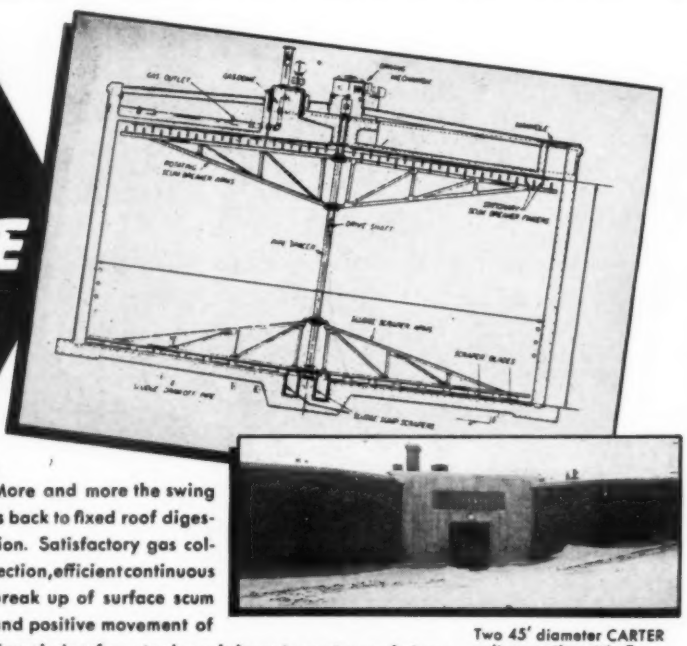
SEVENTY-SIX YEARS HAYS DEPENDABLE SERVICE

COPPER · BRASS · LEAD IRON

WATER WORKS PRODUCTS

HAYS MANUFACTURING CO., ERIE, PA.

CARTER *FIXED ROOF SLUDGE* DIGESTER



- Sturdy rugged design . . . a tough unit built to adequately handle a tough sewage treatment job.
- Totally enclosed triple reducer drive direct connected to double parallel gearhead motor . . . eliminates inefficient chain drive . . . minimizes maintenance.
- Mechanical and electrical overload protection . . . doubly safeguards entire mechanism from damage.
- Galvanized steel gas dome . . . fabricated from heavy plate, electrically arc welded, then hot dipped to prevent corrosion.

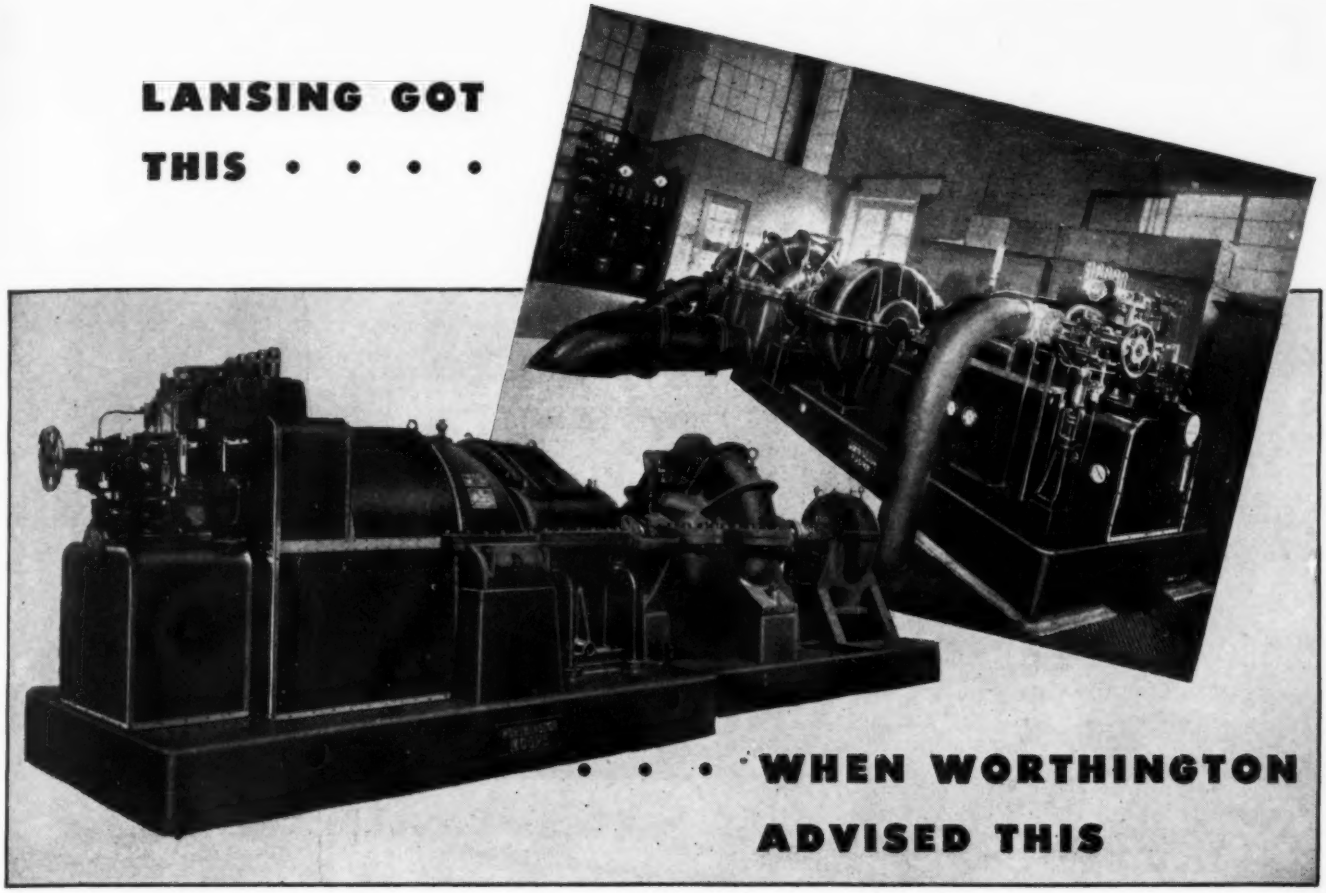
More and more the swing is back to fixed roof digestion. Satisfactory gas collection, efficient continuous break up of surface scum and positive movement of ripe sludge from tank periphery to center pocket are a few of the reasons. Dangers of cover tilting, short circuiting, and loss of storage space due to excessive grit deposits are eliminated. Our engineers will gladly advise you on your requirements, or—

Two 45' diameter CARTER units operating at the Town of Tonawanda, N.Y. Consulting Engineers — Nussbaumer & Clarke, Buffalo, N.Y. General Contractor— C. E. Knowles & Co. Inc., Gowanda, N.Y.

➡ *Write for Bulletin 4311*

RALPH B. CARTER CO. HACKENSACK, NEW JERSEY 53 PARK PL., NEW YORK 7, N. Y.

LANSING GOT THIS • • • •



• • • WHEN WORTHINGTON ADVISED THIS

The Result: Tops in Operating Efficiency and Economy

In 1941, the City of Lansing, Michigan installed this Worthington 20″ x 24″ — LC-3 volute centrifugal pump driven by a Worthington 5000 rpm Steam Turbine. The pump is rated at 10 to 20 MGD against 150 to 200 ft. head. After four years of service, it still rates tops with the City of Lansing, on the basis of operating efficiency and economy.

It's not surprising that it should. Laboratory tests, initiated by Worthington in 1918 on actual pump models, are backed by installation and field testing under supervision of a trained Worthington field engineer — a sure guarantee of efficient performance. You know you're on safe ground when Worthington *wins* the bid.

ADVANTAGES OF WORTHINGTON'S *COMPLETE* LINE

Another reason why more jobs go to Worthington is demonstrated in the Lansing installation . . . *completeness of line*. All of the elements making up this Worthington steam turbine driven, condensing, centrifugal waterworks pumping unit are manufactured by Worthington . . . pump, geared turbine, condenser and auxiliaries providing *undivided responsibility*. That one reason is why Worthington is first choice for so many municipal waterworks.

For specific information on Worthington LC-3 Centrifugal Pumps as installed in the City of Lansing, write for Bulletin W-312-B9A. It proves that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Harrison, N. J.*

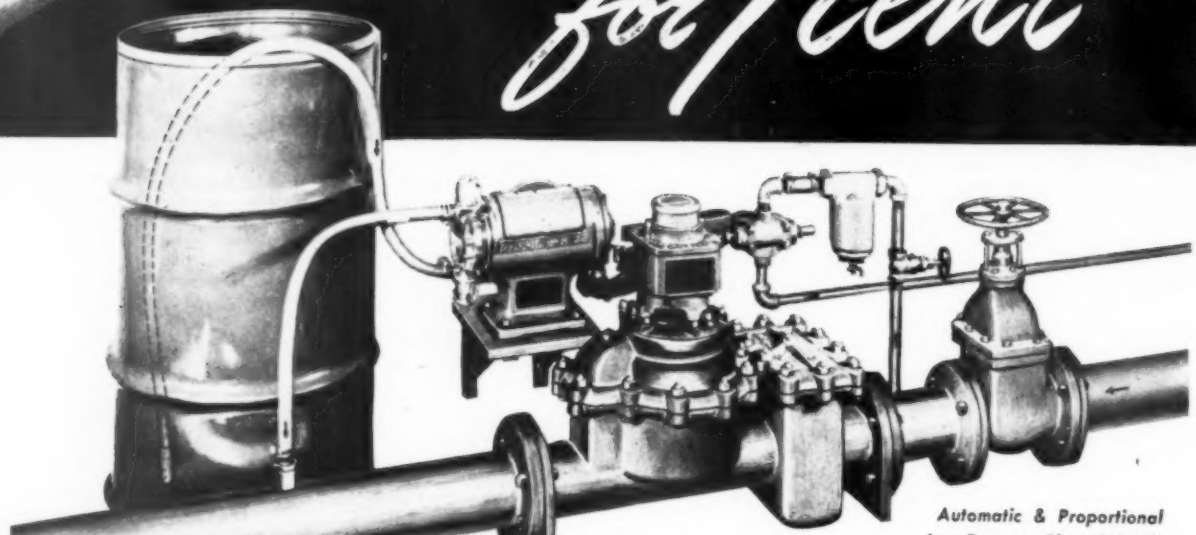
MORE JOBS GO TO WORTHINGTON

The complete line . . . the top engineering

Centrifugal Pumps
Diesel & Gas & Sewage Engines
Dual-Fuel Engines
Turbines & Turbine-Generators
Gas Engine-Compressors
Stationary Compressors
Water Softening, Filtering Equipment
Vertical Turbine Pumps
Water Meters
Power Transmission Equipment
Portable Compressors & Air Tools

WORTHINGTON

24WS-5



Automatic & Proportional
Low Pressure Chem-O-Feeder

That is the cost over a 10 year period of %Proportioneers% Automatic & Proportional Hypochlorination equipment for a 500,000 gallon per day gravity water supply.

For this insignificant cost your community can not afford to be without the adequate protection supplied by continuous chlorination with %Proportioneers% accurate, safe and dependable Chem-O-Feeder. What water department customer would be unwilling to shoulder his share of such a *health insurance investment* if aware of the small equipment expense per gallon to sterilize his water supply for protection against water borne disease?

Other water supply companies using more or less than 500,000 gallons daily can also have this protection of continuous sterilization for a correspondingly small investment. Write today for cost data on your Automatic & Proportional Chem-O-Feeder. You need only tell us your daily average consumption, minimum and maximum GPM flow and the water pressure at the proposed installation location.

BEFORE YOU SEND IN YOUR PENNY READ THIS:
Figure based on complete equipment needed to inject hypochlorite solution against less than 100 psi, including mechanical water meter to control chemical feeder through range of 20 to 525 GPM. Solution tank and chlorine residual test kit are included, plus estimated maintenance cost and depreciation over a period of ten years.

% PROPORTIONEERS, INC. %

9N CODDING STREET • PROVIDENCE 1, R. I.

WATER & SEWAGE WORKS

E. S. GILLETTE, Publisher
330 South Wells Street, Chicago 6, Ill.

L. H. ENSLOW, Editor
155 East 44th Street, New York 17, N. Y.

COMING!

"Developments of 1945 in Sewage and Industrial Waste Treatment"

Will be featured in our February number as usual. In addition to the recording of developments in sewage and industrial waste treatment, progress in the abatement of stream pollution generally will also be discussed, along with a discussion of trends and "things to come." The author is no less than the eminent authority, whose earlier reviews, written expressly for *Water & Sewage Works*, have been so highly appraised by our readers—

DR. FLOYD W. MOHLMAN, Chief Chemist,
The Chicago Sanitary District, Chicago.

"Stopping Water-Hammer"

Reveals the method employed to correct a serious water-hammer problem at a small pumping station. A correctly proportioned air chamber did the job effectively and economically. A description of the installation in detail, with an exhibit of performance, comes from—

MAURICE A. LIBBY, Supt.,
Bath (Me.) Water District.

"Cavitation in Pumps"

Is an excellent discussion of the phenomena and truths concerning cavitation in centrifugal pumps. This paper reveals some misconceptions generally held concerning the causes of cavitation, and suggests methods of correction of this noisy and destructive condition, which is more commonly experienced than is generally realized. This article was prepared at our special request in order to clear up many false conceptions concerning the cause, effects and proper measures for the correction of damaging cavitation. The author is—

ROBERT W. ANGUS, M.E., Prof. Emeritus,
Dept. of Mechanical Eng., Univ. of Toronto.

"Operating a Long Sewage Force Main"

Is an interesting account of experiences in operating an unusual sewage force main 5½ miles in length and passing over 8 summits. The author reveals the method used to successfully relieve air pocketing at these summits and at the same time holding syphonic effects which reduced pumping heads and increased line capacities. Also the results of simple main cleaning with a "go-devil" reveal the economic advantages of such systematic cleaning. The author is—

COL. A. C. WHITNEY, Supervisor,
Water and Sewerage, Twin-City Ordnance Plant, Minn.

"Stop Guesswork in Copper Applications"

Is the theme of an article describing how by a simple procedure of alkalinity titration, as the basic factor, the correct dosage of copper sulphate may be determined. A history of the effectiveness of the scheme over a period of years, without over or under treatment, is related by—

WM. D. MONIE, Chemist,
Commonwealth Water Co., Summit, N. J.

Control of Activated Sludge Bulking

Two articles on this topic seem convincing proof that chlorination of the recirculated sludge, if properly applied and proportioned, will do a remarkable job whenever trouble is brewing. One article* supplies a tested formula, based on sludge density and organic content, for determining the correct chlorine dosage. These articles are the contributions of—

J. K. ADAMS, Supt. of Sanitation,
Tenefly, N. J.
*J. A. TAPELSHAY, Development Engr.,
Chicago Pump Co., Chicago, Ill.

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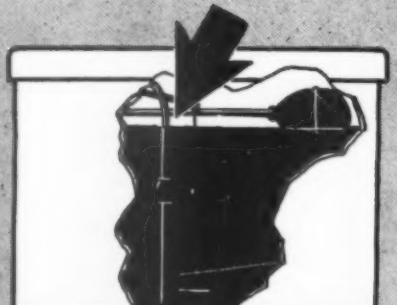

The overflow pipe, often silent and unsuspected, has been found by experience to be one of the largest wasters of water. Running steadily, at low rates of flow, its leakage will not be registered on meters which are not maintained in good condition. If the meter will not operate on ¼ of a gallon a minute, not an unusual leakage rate, over 10,000 gallons per month will go unaccounted and uncharged for.

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WATER & SEWAGE WORKS

VOL. 93, No. 1 JANUARY, 1946

A Gillette Publication

DEVELOPMENTS IN WATER SUPPLY IN 1945

A Review

By LEONARD N. THOMPSON*
General Manager
WATER DEPARTMENT
ST. PAUL, MINN.

DURING the past several years of intensified war effort almost all of our thoughts were directly connected to the machinery of war and normal plans were relegated to a place of secondary importance. A national effort was needed to jar our sensibilities into a realization that peace would finally follow war and that we owed to those in the fighting services a certain security to which to return.

The Author

V-E Day and V-J Day followed each other in such a relatively short order, however, that in spite of what we thought were well laid plans, we very suddenly found ourselves with the tomorrow that, yesterday, had appeared almost a mirage. We found ourselves suddenly engulfed with problems of reconversion, relocation, and readjustment. Despite some setbacks, reconversion in general is progressing at a most hopeful rate, unemployment is less than anyone had expected or estimated, and the most hopeful sign in the relationships between management and labor is an honest desire on the part of both to find a common ground for sane discussion.

*President of the Amer. Water Works Assn.

The past year found that the water works industry had finally won its own war of greatly accelerated production to meet the demands of a highly geared war industry. The days of feverish expansion had largely leveled off to the job of maintaining satisfactory and sufficient service under continued abnormal conditions. New construction for private and municipal purposes has been almost non-existent except in the most urgent cases.

Any review of the past year would indicate a very definite growing tendency among water works managements to devote more thought to improving the quality of their product, providing better service, raising the standards of employment as well as obtaining job security. Many cities are now advancing plans for water softening; and reduction of unaccounted for losses, better meter registration, water works schools, expansion of pension systems and retirements are being given deep study.

Some lessons learned during the war were: The need for adequate supplies, preparedness for any foreseeable emergency, the effective usefulness of mutual aid, and the need for adequately trained personnel to permit advancement and replacements without undue drop in operating effiiciency. An aftermath of the war is the need for an estimated $200,000,000 worth of deferred maintenance in water works properties.

The OWU in Retrospect

In an administrative letter dated Sept. 27, Edw. Falck, Director, Office of War Utilities, advised of the revocation of Utilities Order U-1 and end of the office. The activities of the War Production Board have been taken over by the Civilian Production Administration (CPA). In his administrative letter, Mr. Falck expressed to all utilities his sincere appreciation of the part they took in the discharge of a common responsibility. With the passing of the U-1 order, all orders in the hands of manufacturers automatically became unrated as of September 30, unless a CC rating is applied for and granted.

As we look back, water works operators universally recognize the wisdom of the governmental priorities and regulations which were established and under which we labored for some considerable time. The Utilities Division, set up under the War Production Board and so ably administered by Mr. Arthur Gorman, a member of the American Water Works Association, was a defense in the operation of the water industry. The finest co-operation existed between these agencies and the water works operators, and gained for us security in the purchase of vital operating supplies and protection against the disruption of vital service. At no time was there a serious prolonged breakdown in

the production of war materials due to a failure of our water supplies.

AWWA Activities

In general, the past year has seen very substantial progress made by the American Water Works Association in its service to the industry. The adoption of a "Code of Practice" by the profession was a most laudable and forward step and should finally give to all good operators a better standing in the eyes of the public. The results of a study committee to evaluate methods which can be used to promote better public relations and public appreciation of water supplies are expected to be far reaching. The continued growth of the Association presages further expanded activities.

Anticipated adoption of USPHS standards for drinking water as the standard for all water works to follow; support in general principle of proposed legislation for the control of stream pollution; associate membership with the U.S. Chamber of Commerce, are all forward looking steps for the upraising of the entire profession designed to gain public appreciation and add prestige to the profession.

The American Water Works Association is very much interested in the question of stream and water pollution. It is a national sin that we have taken so little action or given so little thought as a nation to the conservation and protection of our water resources. Without any reference to where responsibility lies or where municipal, state or Federal authority should start or stop, water works men, collectively, should be deeply concerned with the problem and assume leadership in its solution.

In January, 1945, an unusual, but laudable, event took place when a joint meeting of water works operators and fire chiefs was held at Manchester, N. H.

At Toronto on March 19-21 the Canadian Section held its Silver Anniversary meeting and celebrated by breaking all previous attendance records by a large margin. Its growth from an attendance of 32 at its first meeting in 1920 to approximately 900 this year calls for our heartiest congratulations. To this Section we are also indebted for the creation of the water works club room idea which appears to be gaining in popularity wherever tried.

Water and the War

In passing from war to peace, we should pause long enough to salute those members of the armed services who carried on the work of the water works profession in far distant places. Developing ground water supplies on Guam, Iwo Jima, and elsewhere on Pacific islands, as well as supplying troops in every theater of war, brings credit to water works men in general.

One of the factors in water supply in the Pacific was a new type of water storage tank made of flexible glass fabric coated with synthetic rubber. This collapsible tank (11 ft. in dia., 4½ ft. high) which can be folded, resists fungus growth, is light in weight, water tight, durable, and gives no taste or odor to the water. It may find peace time use in emergencies.

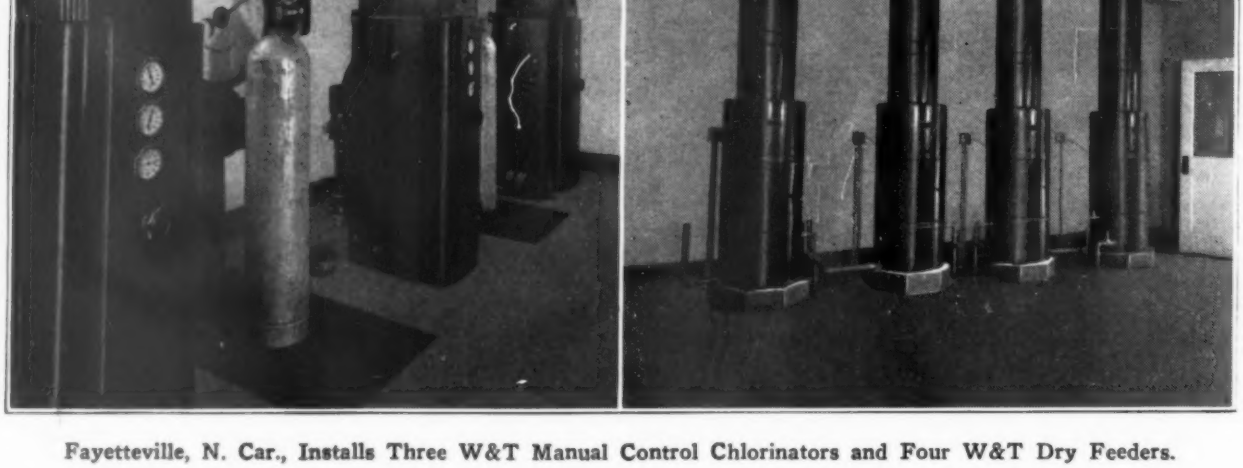
Men returning from water supply service in the war will find a welcome in water utilities, which can well use their invaluable experiences gained under hardships and difficulty.

The story of London's fight to maintain water service in spite of bombing was released and gave Americans more cause to be thankful that the ravages of war did not touch us. At the same time that story proved again that water works men can successfully meet the worst catastrophe, for in five years of war, despite terrific damage, no single case of typhoid fever was recorded.

Postwar Work

By the beginning of 1945 the mad rush of many water departments to extend facilities to meet enormously increased demands made by war industries had mostly subsided, and major extensions made by local funds or through Federal aid, secured under authority of the Lanham Act, were being superseded by plans for extensions which would be required after the war to meet more normal demands. The campaign for postwar planning was continued by the Committee on the Development of Water and Sewage Works. By midyear the total water and sewage works in the planning stage was estimated at 20 billion dollars.

A survey made following V-J Day, however, revealed that less than 10 per cent of the planned work was ready for bids. High prices for both labor and materials, a scarcity of



Fayetteville, N. Car., Installs Three W&T Manual Control Chlorinators and Four W&T Dry Feeders.

Mayor Kelly Addressing the 600 Persons Attending the Opening Ceremonies of the World's Largest Filter Plant in Chicago.

materials, a certain uncertainty, and in many instances a slow-down or hesitancy in anticipation of Federal aid, have all been contributory factors to delay. A huge backlog of badly needed maintenance is marking time. In the meantime, the country-wide housing shortage which calls for the construction as soon as possible of hundreds of thousands of new homes, is of concern to the entire water industry, as it will mean the installation of substantially the same number of new services, and heavier demands on our supply services.

Stimulation for advance planning was given by the Federal Government which appropriated 17½ million dollars for use in planning public works. Part of this fund is still available and more is hoped for by the Federal Works Agency. The states of New York, Illinois, California, Michigan, Pennsylvania, and Texas were leaders in the encouragement of postwar planning by providing state funds for the same purpose. Under the terms of the Pennsylvania Act, private interests can obtain the same aid as publicly owned utilities for the design of industrial waste plants, and can obtain 50 per cent of the cost of constructing a pilot plant for experimental purposes upon evidence that no satisfactory method has been developed and successfully used for a particular waste treatment.

Surplus Property

Surplus government property with an acquisition value of more than $32,000,000,000 was in process of being declared before the expiration of the year. Every effort is being made to simplify the disposal of this material and extend to municipalities certain sales priorities. The Surplus Property Administration has conceded to water works a very substantial discount from the normal sales prices.

Management and Labor

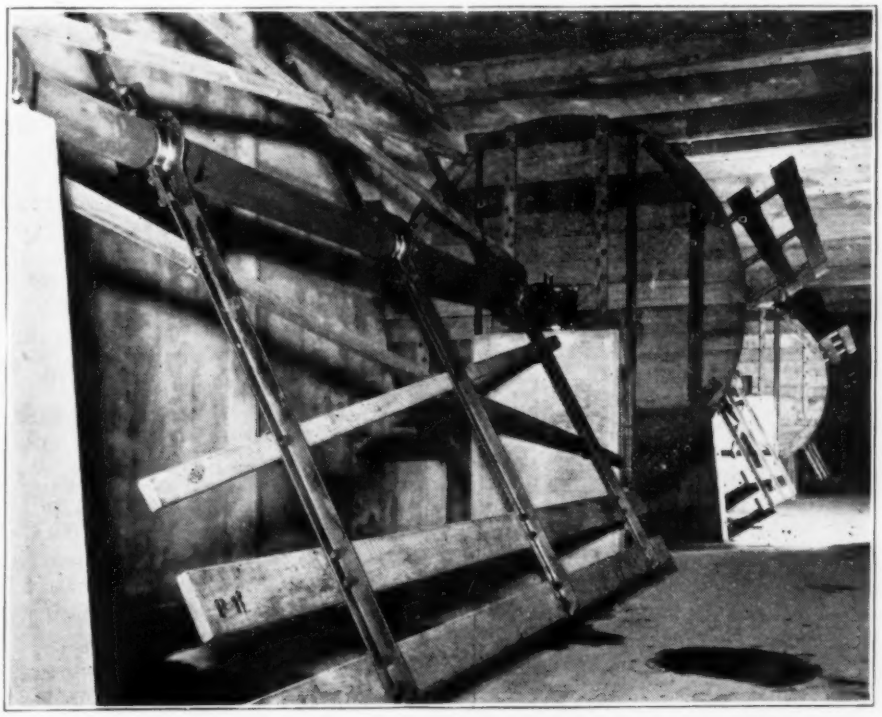
Water departments should be interested in the action of the U.S. Supreme Court in upholding the decision of the Federal District Courts permitting the issuance of water bonds by public bodies with the interest on such bonds exempt from Federal income taxes. This action will have a very favorable influence on municipal bond interest rates.

A new and most progressive step in solving management-employee relationships has been adopted by the municipally owned water utility of Waukesha, Wisc. After considerable study, Arthur P. Kuranz, Manager, submitted to the City's Utility Commission a profit-sharing plan whereby any employee who has been with the department for at least six months during the year shares on the basis of his total wages a part of the department's net operating profit, 4 per cent of the net profit of the department being set aside for this purpose, with a maximum share not to exceed $150 per year. There are several instances where water departments have contributed towards an employees' salary-saving plan for the purchase of retirement annuities. One large department has recently used a part of its surplus for the establishment of an employee retirement plan. The Waukesha plan is the first instance, I believe, where the employee becomes a partner in the business.

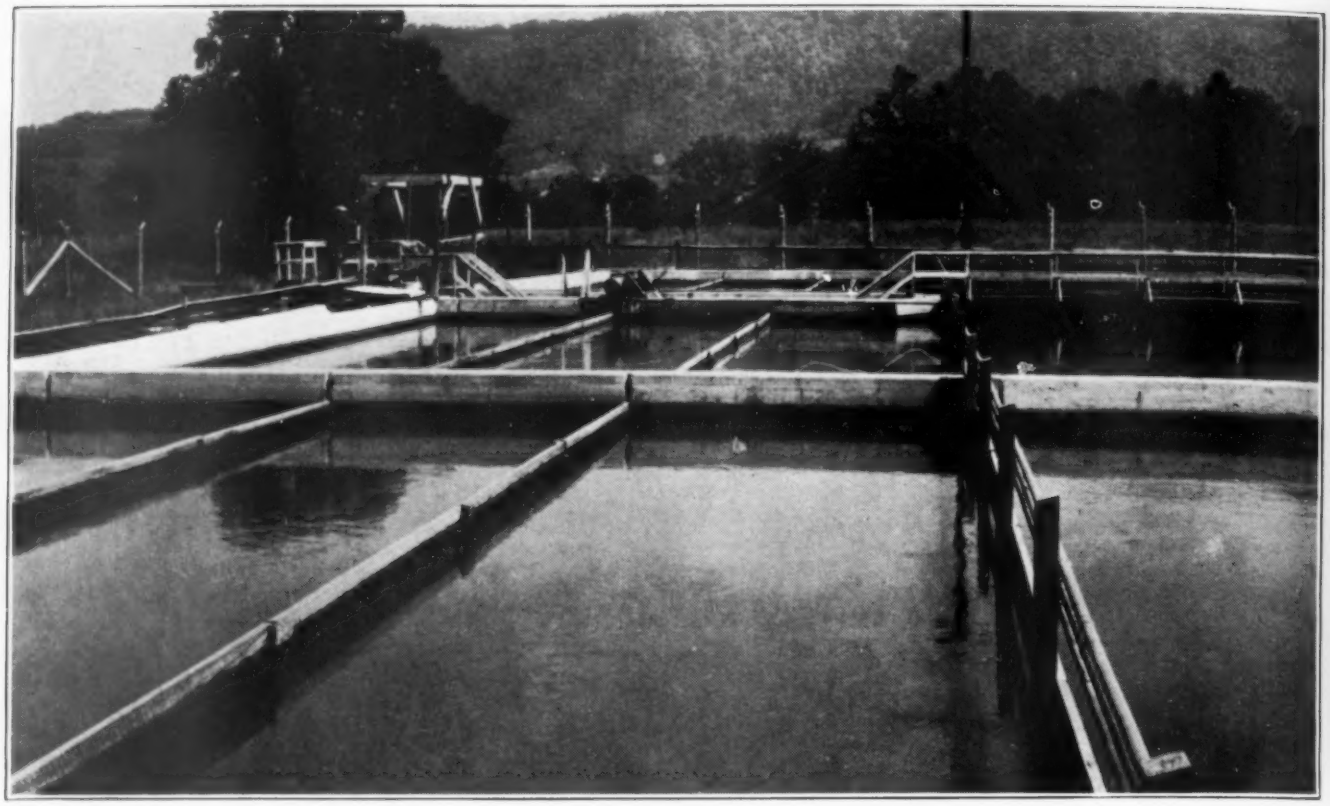
An illegal strike of water works operators occurred at Danville, Ill. in the Fall. For 48 hours the operators were off the job, but water service to the city was maintained by the efforts of the Chief Engineer, the chemist, and two office workers who fired the boilers and ran the high and low service pumps and the filter plant.

New Thoughts

Recent years have seen much development of water works properties for recreational purposes. Construction of public parks, landscaping, and beautification of the grounds for attractive appearance and the enticement of visitors has spread to many water departments. The use of watersheds for reforestation is now becoming increasingly popular, and there are several notable examples where this practice has passed beyond the initial purpose of watershed protection and is reaping good financial returns. Now comes a new idea: The City of Springfield, Ill., faced with a manpower shortage, developed the idea of carrying on its maintenance work by the purchase of a flock of sheep to be used as a municipal lawn mowing machine. The flock was purchased upon advice of the authorities of Animal Husbandry Division of the State University. The sheep have the upkeep job for 2000 acres. The Akron, Ohio,



Flocculators Installed at South District Filtration Plant—Chicago, Ill.



Water Treatment Plant at Holston Ordnance, Kingsport, Tenn.
(Dorrco Flash Mixers and Flocculators)

Water Department, in addition to its sheep industry, uses part of its land for cattle raising.

Cross-Connections

The number of dangerous cross-connections and back-siphonage connections unquestionably increased during the war years due to the large increase in industrial plants, enlargement of plants, changed plant processes, increased fire protection demanded by war agencies, and relaxation of standards due to speed necessary in new construction. A report of the Committee on Sanitary Engineering, National Research Council, stated that in one city alone it found over 15,000 violations of sanitary principles.

Much credit is due those cities that continued a campaign against this danger when exterior causes could well have provided an excuse to lessen their zeal. The work for the elimination of cross-connections was carried out very successfully and notably during the year at Shreveport, La., and Los Angeles, Calif., 50,000 connections having been eliminated in the latter city by the beginning of the year. Paralleling the work of these cities is the action of the American Water Works and Electric Co., Inc., in the adoption of a set of rules and regulations covering cross-connections and inter-connections. This very laudable action on the part of a private company, operating some 70 odd water works, and its public acknowledgment of a moral responsibility, is of far reaching import and an object lesson to all water utilities, public or private.

Fluorination and Dental Caries

On January 25, ten year tests on the application of fluorine to a public water supply were started at Grand Rapids, Mich. (pop. 170,000). Muskegon, Mich., is to be used as the control city. More than 31,000 Grand Rapids school children were examined to establish a dental base-line for evaluating the results. In May, the City of Newburgh, N. Y. (pop. about 30,000) started adding fluorine to the water supply. The control city is Kingston, N. Y. A third city, Brantford, Ontario, Canada, is reported to be planning a similar long term fluorine test treatment.

It is, of course, too soon to attempt to draw any permanent conclusions as to the success of this method of treating for dental caries. Its advisability by water departments, even if successful, is still a debatable question.

Interesting is the study made by John W. Knutson, dental surgeon, USPHS, and Wallace D. Armstrong, University of Minnesota Professor of Physiological Chemistry. These gentlemen carried on their studies by the direct application of sodium fluoride to the teeth of school children. Results were reported to be favorable.

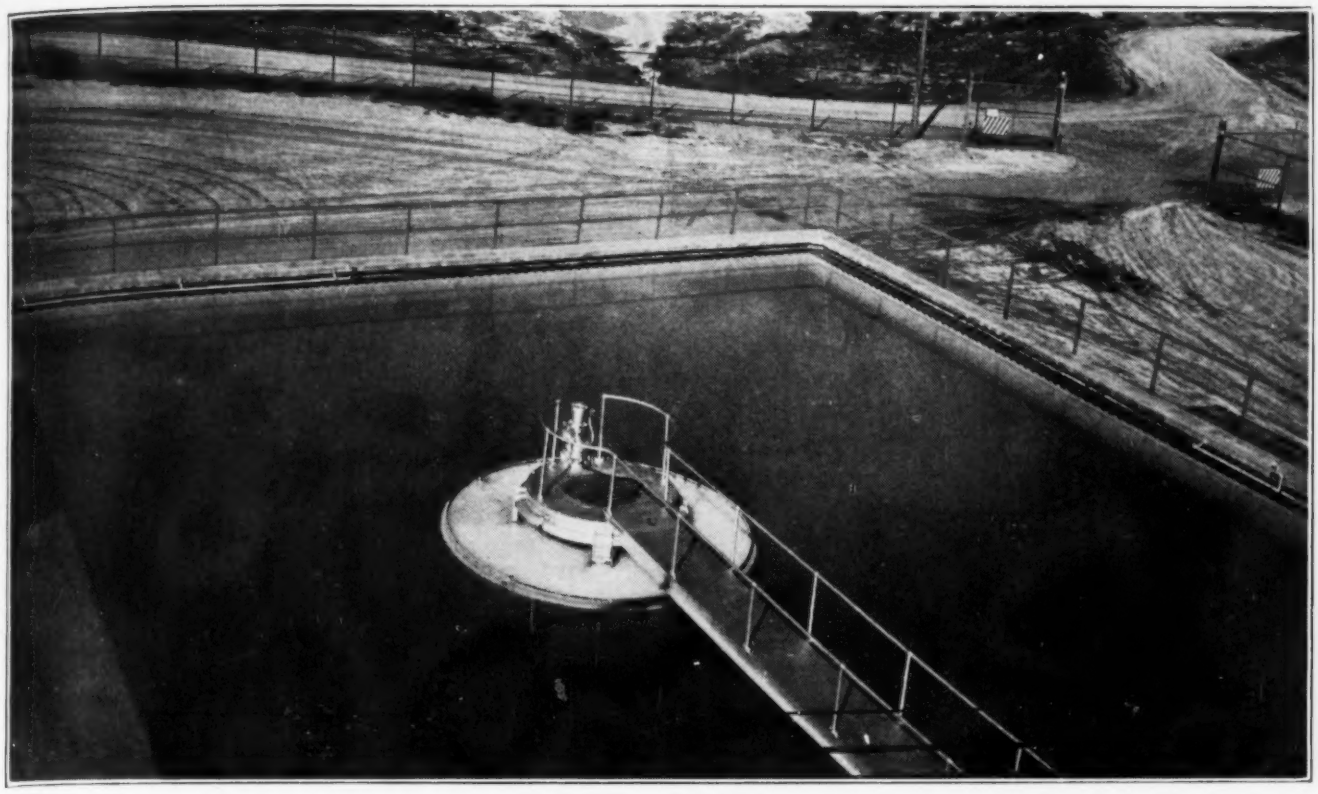
Water Purification

Lime recovery at water softening plants is receiving considerably more attention and it can be expected that several plants will soon be producing sufficient lime for water treatment with an excess to sell. Miami now has plans to start such a process as soon as materials are available. The use of the centrifuge for concentrating sludge and improving the quality of the precipitate indicates a future trend in the disposal of sludge.

Break-point chlorination is being extended. The development of the flash test for residual chlorine and the arsenate test for false residual gives very valuable aids in the control of chlorination.

The use of clay and silica for better coagulation is reported as increasing.

Considerable study and advance is being made in the control of corrosion by water. Army camps have done much research along these lines, and the use of sodium silicate,



Water Treatment Plant, Camp Haan, Calif.—Dorr Primary Clarrifier.

glucosides, chromates and poly-phosphates is being studied very carefully.

The ability of diatomaceous earth filters to remove from liquids microscopic suspended solids of both organic and inorganic nature, including amoebic cysts at high filtration rates, has created great interest in this type of filtration. A filter mat of diatomaceous earth (microscopic skeletons of pre-historic algae) built up on a porous filter septum catches and retains microscopic particles suspended in the water passing through the mat, as the interstices are even tinier than the particles. Due to the fact that a large filter area can be placed in a relatively small tank, and because of the high filtration rate, the size and weight of the equipment is greatly decreased as compared with sand filters. This makes it highly competitive to sand filters, as the first cost, as well as the housing expense of the filters, is much lower. These advantages, plus the fact that the filters themselves can be run by operators having a minimal knowledge of chemistry, have aroused much interest in the water works field.

The demand for soft water supplies continues to grow in many cities. There are approximately 575 municipal softening plants and an estimated 300,000 consumers using household softeners, indicating a growing demand for soft water supplies.

Radio

The general use of radio by water utilities has been very limited up to now, but its possibilities have been so well demonstrated in those cities where it has been used that its popularity will, without doubt, increase and its use soon become very general. This will, however, have to await two things—the availability of sets and proper allocation of radio channels. The Department of Power and Water of Los Angeles has its own station and a large number of radio-equipped cars. It is planned to extend the service as soon as conditions permit.

Through Committee 4 of Panel 13 of the Radio Technical Planning Board, representing the electric, gas, steam, and water utilities, the AWWA filed a request with the FCC to obtain a suitable number of channel allocations to furnish emergency radio service. On January 15 the FCC released its report which now seems to be unduly restricted but is expected to be modified to permit its use by water departments for other than purely emergency service. Fast, reliable communication facilities between the supervising office and a crew or its foreman, doing work over a scattered territory or between crews, either during an emergency or during the performance of a difficult job, is a most important factor. Buffalo, N. Y., has successfully demonstrated the value of two-way radio cars in the location of leaks.

Electronics in the Water Works Field

We have all been highly interested in the use to which electronics have been put in the winning of the war. Many of its secret uses are still not publicly known. Now comes to our attention the almost unlimited uses to which this development can be put in water works operation. Six out of seven major instrument manufacturers are now said to have on the market electronic measuring instruments. The use of high frequency field electronic units to locate buried mines during the war makes rather certain further improvements in our present pipe locators which use the electronic principle. The use of electronic technique in telemetering equipment for the transmission of water levels and water flow over long distances is a distinct possibility, with the elimination of transmitting line difficulties.

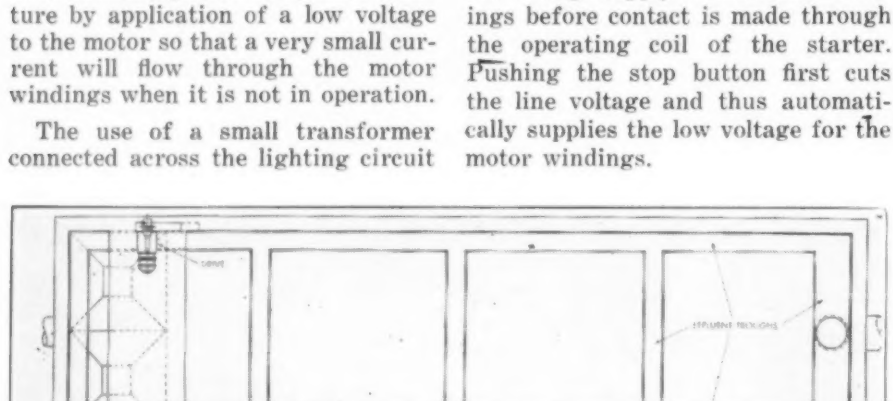
Protection of Electric Motors and Controls

A protective method has been developed for all electric motors subject to water spray or excessive dampness and consequent deteriora-

Pipe Gallery—North Chicago Filter Plant Expansion.

tion of the motor windings. The method eliminates the use of open space heaters. When motors are operated infrequently and in addition are located in extremely damp places or where temperature will vary over a wide daily range, they may be automatically protected against moisture by application of a low voltage to the motor so that a very small current will flow through the motor windings when it is not in operation.

The use of a small transformer connected across the lighting circuit or primary circuit and with several taps on the secondary side (10 or 12 volts usually) can be secured through contacts of a relay to the motor windings. The starting button is designed to break contact with the relay coil, thereby disconnecting the low voltage supply to the motor windings before contact is made through the operating coil of the starter. Pushing the stop button first cuts the line voltage and thus automatically supplies the low voltage for the motor windings.



Rex Verti-Flo Thickener Introduced by Chain-Belt Co.

Silver-Copper-Lead Pipe

As a result of the shortage during the war of lead pipe for water services, English industry has developed a silver-copper-lead alloy pipe, said to be superior to lead. The metal is prepared by using not over 0.005 per cent each of silver and copper with 99.97 per cent pure lead. The vital factor in its adoption is that it permits a thinner wall thickness with greater strength. Tests show it will withstand continuous pressures longer. The alloy shows itself suitable for binding or coiling. It sells for less than lead pipe and is now being marketed to British Standard Institute specifications.

World's Largest Purification Plant

On September 20, Chicago's gigantic, new South District filtration plant was put into partial use. The plant, far from complete because of wartime restrictions on materials and due to lack of labor, will operate as a partial purification plant until completion of the filters, providing pre- and post-chlorination, coagulation and clarification.

The plant was put under construction in 1938 with the expectancy of completion by the summer of 1942, but the wartime restrictions prevented it. This largest water purification plant in the world is supplying 1,350,000 people within a zone representing 54 per cent of the area of the city. When completed the plant will have cost approximately $24,000,000. At present the plant-operating staff is 116, but when, within the year, the filters will be in operation, the operating staff will be about double the present number.

Conspicuous to the visitor is the amount of wood used temporarily in the plant until aluminum, stainless steel, etc., can be had.

At the standard loading of 2 gal./sq.ft./min. rate, the filters have a capacity of 320 mgd. The demand already exceeds this output, however, and the filters are designed to turn out 500 mgd. whenever called upon to do so. The raw water pumps have an overall capacity of 532 mgd. On October 18 it was putting out about 450 mgd. of clarified water with a turbidity of 2 ppm. or under, even without the filters. Even with the temporary operation and but partial treatment, the quality of the raw water has been greatly improved.

North Chicago, a suburb of the City of Chicago and located on the shore of Lake Michigan, is completing an expansion program to its water system. The new construction involves the installation of a new in-

take extending 1,200 feet into the lake, additional settling basins, and clear well capacity, filter beds, and a one million gallon concete surface reservoir.

An interesting feature of the work was the installation of the 20-inch cast iron mechanical joint type joints. The work was performed during the winter, at times at temperatures of 12 degrees below zero. The pipe trench was dug in a hardpan or shale by a clam-shell bucket operated from a barge. Divers were used to connect the assembled sections under water.

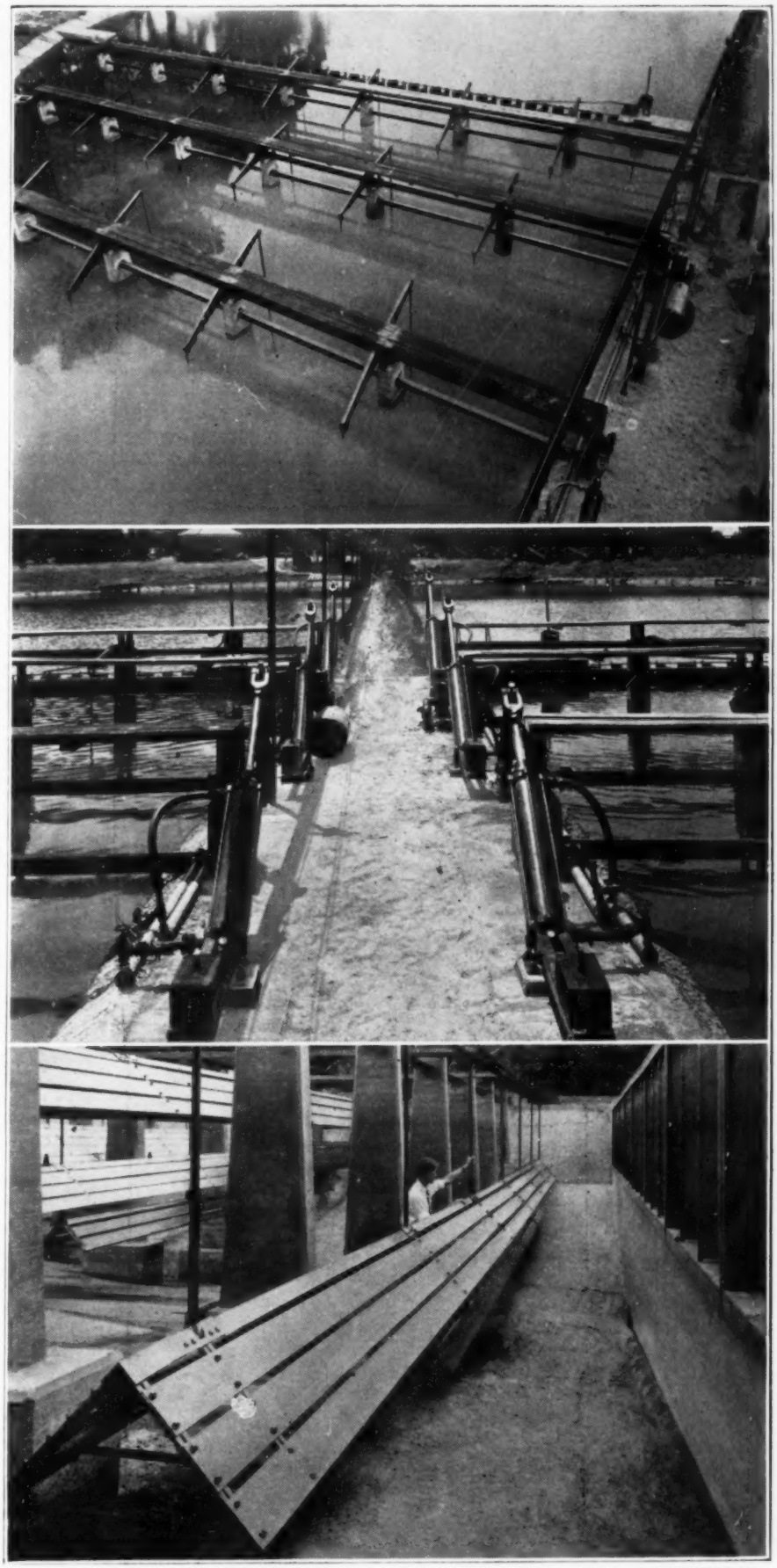
Detailed plans are in progress to install new mains, enlarge the filter plants, and construct new storage reservoirs in the East Bay Utilities District metropolitan area in California. This district is composed of the nine cities of Oakland, Berkeley, Alameda, Richmond, El Curito, Albany, Emerville, Piedmont, and San Leandro. The total present area of the District is approximately 190 square miles. Prior to the war the population served was about 590,000 and water consumption about 46 mgd. It is estimated that the population today is about 850,000 and consumption about 98 mgd. due to the large industrial development and large influx of war workers. Regardless of the fact that consumption in the District has about doubled, the operations have been carried on with a reduction in the personnel of about 28 per cent.

Novel Idea

At Grand Canyon, Ariz., engineers of the Santa Fe Railway developed a novel method for preventing the solid freeze-up of the riser to an elevated water tank by intermittingly circulating water from the bottom upwards through the tank. Briefly, it involves the installation of a suction tee eductor (Watson and McDaniel) on the end of the filling pipe. A 2½ inch drop suction line from the eductor picks up water at the rate of 30 gpm. from the bottom of the riser and discharges it into the center of the tank to mix with the warmer water. While an ice shell of 2 inch thickness has been found in the riser, the circulating scheme has prevented further ice shell encroachment.

Salt Water Encroachment In Florida

Drainage for reclaiming swamp lands in southern Florida has upset the delicate balance that exists between salt water and fresh water in the aquifer along the coast, and has generally lowered the water table almost to sea level several miles in-



The Stuart Walking Beam Flocculator Installed at Norfolk, Va.
(Top View—Looking down on walking beams. Center View—Hydraulic mechanism for driving walking beam flocculators. Lower View—Close-up of tiers of inverted trough paddles of flocculators.)

Two-Way Radio Being Used To Locate Water Main Leak in Buffalo, N. Y.

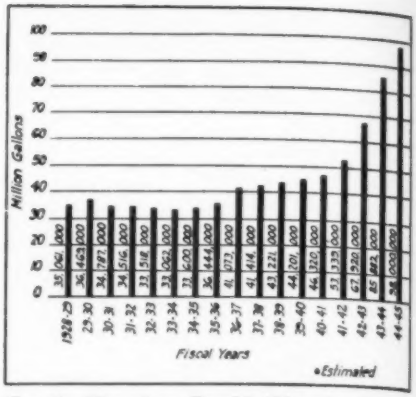
land from the ocean. This has resulted in the incursion of salt water in uncontrolled canals at times as far as 10 miles from the source of the salt water, and has brought about local salting of ground water apart from the contamination that is taking place at depth in the aquifer.

This latter form of salt water encroachment has moved landward in an uneven front, with lobes extending inland along some of the drainage canals for several miles. This movement is in direct consequence of a lowered water table, and is especially notable along the Atlantic Coastal Ridge, where the fresh water head is no longer sufficient to prevent encroachment of salt water. This movement will continue until a point is reached where the average annual height of the fresh water above mean sea level is sufficient to prevent further encroachment.

Near Calamities

On January 8 a flood on the Susquehanna River, caused by an ice jam, cut off the water supply of Columbia, Pa. (pop. 12,000). The water plant was out for four days and only prompt action in the installation of emergency equipment averted a second shutdown when a second and more serious flood condition occurred on February 25.

On January 24 water service to all non-essential industries in Columbus, Ohio (pop. 340,000), was ordered stopped, together with an immediate reduction of at least 30 per cent in all domestic uses of water. This serious situation was caused by the sudden stoppage of the outlets of the O'Shaughnessy and Griggs dams due to accumulation of fish and general debris. This caused the shutdown for 21 hours of the big Curtiss Wright airplane plant.



Graph Showing Rapid Rise in Water Consumption at East Bay Municipal Utility District.
(Data in Avg. Daily Pumpage)

New Equipment

Almost without exception, waterworks manufacturers have been de-

Adjustable Venturi Distributing Baffle Installed at Norfolk, Va.

Clayton's Hydromatic Cushioned Check Valve.

voting their major efforts to the manufacture of war materials; there has been little development of new products for the trade. It can, however, be anticipated that as soon as these plants have been completely reconverted and are producing under normal conditions, many improvements can be expected and in many instances entirely new ideas and materials introduced to the industry. New installations were not numerous—some in service camps, a few in municipal utilities.

In spite of the general lack of new equipment ideas, the year 1945 did see the first full size installation of the Stuart-Carter Walking Beam Flocculators and Adjustable Venturi Throat Distributing Wall at Norfolk, Va.

Another equipment news item of interest was the introduction of the Hydromatic Check Valve manufactured by the Clayton Mfg. Co. This valve, which operates like a hydraulic door closer, cannot slam and is said to positively prevent surge.

The Pittsburgh Equitable Meter Co. (now the Rockwell Mfg. Co.) introduced a new compound water meter with a single register. Through use of an over-riding clutch coordinator the single register records the flows of both velocity and displacement measuring units. A feature of the unit is that both velocity and displacement units and meter units operate at all flow rates.

Drinkwater, Inc., has developed a new line of flexible pipe couplings made in 11 sizes from 1½ to 16 in. and known as the Presto-Lock Couplings. The couplings are three piece corrosion resistant malleable iron castings with a quick locking wedge key and three types of gaskets, synthetic rubber, neoprene, or natural rubber to give the joints up to 40 degree flexibility at each joint.

Stuart-Brumley marketed a new "Sponge" alum, an improved alum which by nature of its porosity disintegrates and dissolves almost instantaneously on hitting the water when fed from dry feeders.

Builders-Providence, Inc., reports important developments in the operation of Loss of Head and Rate of Flow Gages for filtration plants such that the usual cables and counterweights are no longer required.

Wallace and Tiernan Co. offered a new high precision altimeter. With a sensitivity of one part in 8,000 and an accuracy of 0.1 per cent, this altimeter is ideally suited for use in surveying, prospecting for water supply sources, and other engineering uses.

New laboratory equipment included the Taylor-Betz Nitrate Slide Comparators and the Poly-Phosphate Comparator developed by the W. A. Taylor Co., and the new series La

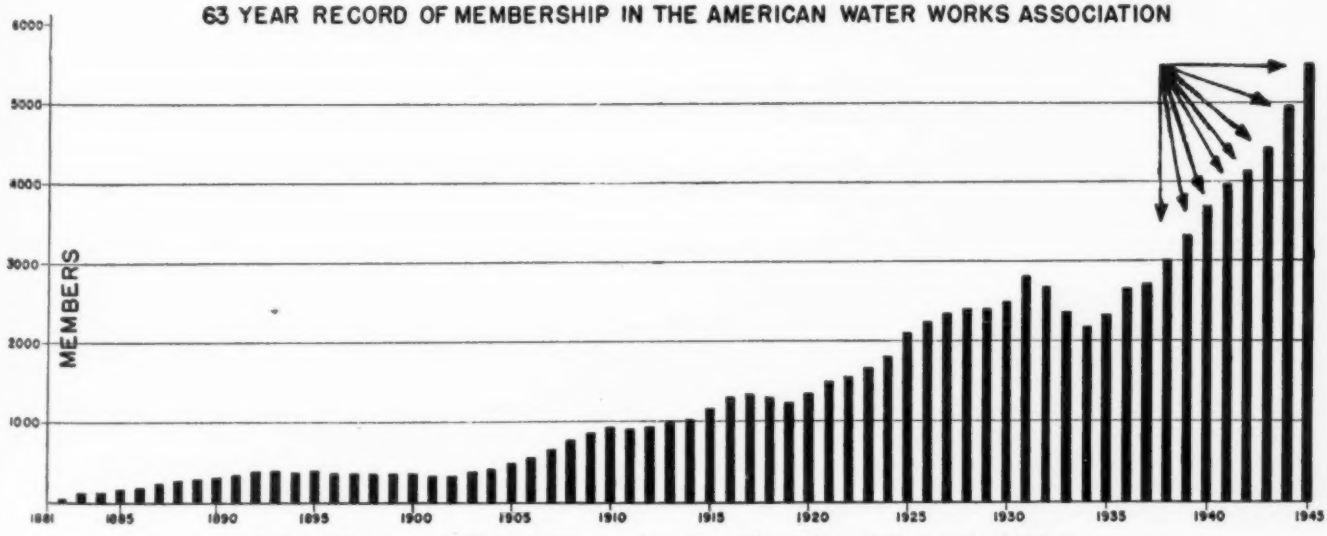
Builders - Providence Flo-Gage For Small Pump Lines, Pressure Filters, Softening Plants, Air Washing, Etc.
(May be graduated in percentage flow or directly in rate of flow units)

Motte Chlorine Comparator and Testing outfits.

Industrial Chemical Sales Div., W. Va. Pulp & Paper Co., introduced a newly developed product, Indulin, a lignin derived from pine wood. Synthetic resins, prepared from lignin, have the property of ion exchange or will remove iron from water and prevent caustic embrittlement in boilers when added to boiler feed water.

The Dorr Co. placed on the market a compact De-Ionization System for quickly converting raw water into an equivalent to distilled water. At costs less than distilled water, the De-Ionization System will rapidly produce a water that is useful in many special industries.

Chain Belt Co. brought out the Rex Verti-Flow Thickeners for use in water treatment plants. This thickener employs a unique, cellular

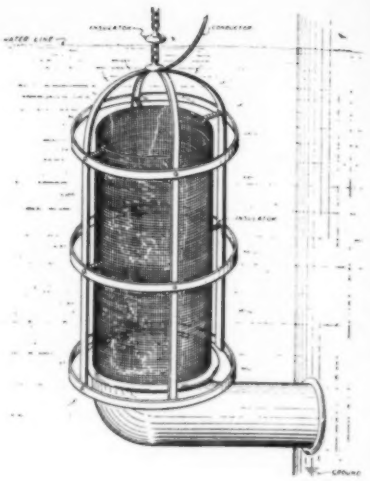


63-Year Record of Membership in the American Water Works Association.

Pittsburgh-Equitable New Compound Meter.

construction obtained by dividing a conventional sedimentation basin with proper weirs and baffles. Long weir length is obtained with the design, and in one installation in the Midwest this Verti-Flow principle increased the capacity by 300 per cent, at the same time improving the effluent.

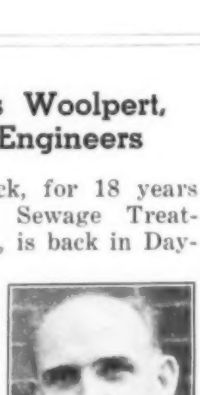
Several other new equipment items not developed expressly for the water works industry will find use in any water plant. These include the all purpose Electric Marker by Ideal Commutator Dresser; Cam-Stat electric controls for temperature, pressure, humidity, etc., by the Paul Henry Co.; Foamglas insulation by Pittsburgh-Corning Corp.; and an All Aluminum Utility Ladder by Duo-Safety Ladder Co.



Burkey Electric Fish Screen.

Tatlock Joins Woolpert, Consulting Engineers

Myron W. Tatlock, for 18 years Superintendent of Sewage Treatment, Dayton, Ohio, is back in Dayton after 21 months of service in the Military Government section of the U. S. Army in the European Theatre of Operation. Tatlock, who entered the army as a major and was discharged as a lieut. colonel, served as Public Works and Utilities Officer on Military Government units in France, Belgium, Luxemburg, and Germany, and was engaged in the restoration of destroyed water and sewage plants. In this work he was associated with the 1st, 3rd, 7th and 15th Armies, and before leaving Europe was Utility Officer in the Headquarters of the 7th Army in charge of restoration work in the entire western zone of American Military occupation.



On his return from army service, Mr. Tatlock resigned his position as Superintendent of Sewage Treatment of the City of Dayton to become an associate with Ralph L. Woolpert Co., Consulting Engineers, of Dayton, Ohio.

"Tat" Tatlock, as he is affectionately known among all water and sewage works men throughout the country, will be in charge of all municipal and sanitary engineering phases of work for the Woolpert Company.

American Water Works & Electric Co. Reorganized

According to an announcement recently received, the American Water Works and Electric Company is to be reorganized in accordance with the requirements of Section 11 of the Public Utility Holding Company Act of 1935. Under the reorganization, there will be two separate entities, one for water works properties and the other for electric properties and other business. These changes will not affect local operation of the company's property, but the segregation of water works property will include the Water Works Service Co., which will also continue in its present organization.

Correction Please!

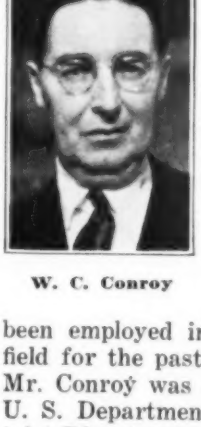
Musser Unintentionally Promoted

On page 341 of the November issue of *Water Works & Sewerage* in the report of the Michigan Water Works Conference there appeared a picture captioned "Water Superintendents All." Included in this group was Mr. John W. Musser of Flint, Mich. Mr. Musser writes, "This is a great exaggeration; Mr. E. L. Holloway is superintendent of the Flint Water Department."

It was with no intent on our part that Mr. Musser was apparently promoted to Mr. Holloway's position. Actually Mr. Musser is Senior Chemist of the Flint Water Department, and we assumed that in that position he was Superintendent of Filtration. We did not, in fact, give Mr. Musser the title of Superintendent in the caption under his own immediate picture. It was merely that the caption for the group of four pictures was somewhat misleading.

W. C. Conroy New Secretary of NEWWA

Walter C. Conroy, General Supt. of the Belmont, Mass., Water Department, has been appointed Secretary of the New England Water Works Association. Mr. Conroy was appointed to take the place of the late Frank J. Gifford who died on October 5th of last year.



W. C. Conroy

A member of the NEWWA since June, 1929, Mr. Conroy has been employed in the public utility field for the past 26 years. In 1930 Mr. Conroy was associated with the U. S. Department of Labor as District Director for New England, and in 1932-33 was State Director of Employment from Massachusetts for the U. S. Employment Service. A member of the Belmont Board of Water Commissioners from 1928 to 1935, and Chairman of that board in 1932 and 1933, Mr. Conroy became the Office Manager of the Belmont Water Department in 1936. He was appointed General Superintendent in 1941. The New England Water Works Association maintains an office and library in the Statler Building, Boston.

GUIDES AND CHECKS ON WATER WORKS OPERATION*

By LOUIS R. HOWSON
Alvord, Burdick & Howson, Engrs.
CHICAGO, ILL.

EVERY golf course has its "par" and every confirmed golfer his "handicap." The object of both is to improve the player's performance.

The Author

In the water works field the major holding companies have developed a system of yardsticks or checks upon the operations of their respective properties, individually adapted to the variations in service conditions, equipment and other facilities available for the service. These checks undoubtedly pay dividends for those companies and are an important part of the holding companies' service to their operating properties. However, but a very small percentage of all the water works systems in the country are under holding company operation, and it is for the purpose of providing some general yardsticks for the large number of independently operated systems that this discussion is written. These yardsticks must necessarily be general but material deviations from the general range should flag the operator's attention and will usually indicate the desirability of investigating the causes for the lack of conformity. In most cases this will result in improved operation.

Starting with the widest generalities, it may be stated that the over-all number of employees in the operating and maintenance departments of the average water works will be within the range of one employee for each 800 to 1,200 population for cities of about 25,000 population, becoming less with greater populations and usually averaging one employee to each 1,500 to 2,000 population for cities in the million population bracket. Obviously, individual cities are affected by remote and widely scattered sources of supply, pumping stations, purification plants, etc., but the above figures are sufficient to indicate a very general range in total personnel.

Water works revenues in other than the more arid sections of the country normally range from $5.00 to $7.00 per capita per year. Operating expenses other than depreciation normally average approximately $2.00 per capita, with a range of from $1.25 to $3.00 per capita. The investment in property will average around $70 per capita and the annual depreciation charge will vary from approximately 75c per capita average for private water works to $1.25 per capita on municipally operated water works where the retirement reserve is largely utilized for new construction.

From these generalizations more specific reference will be made to some items of water works operation and their costs in which economies can most frequently be effected.

Pump Efficiency

Too few operators have information relative to the operating efficiency of their pumping equipment or what constitutes efficiencies practicable of attainment. In recent years there has been a noticeable trend toward motor-driven centrifugal pumping equipment, with which the following discussion is concerned.

Deep Well Turbines

Deep well turbine pumps are most frequently of low efficiency, due to the fact that they are usually installed from 100 to 300 ft. below ground surface, are out of sight and costly to remove for inspection. Over the years, however, they have been developed to a high degree of reliability.

It is now practicable to secure new equipment of this type in capacities of 700 gpm. and upward, which will operate at from 67 to 70 per cent or higher wire-to-water efficiency. It is the author's belief, based upon personal observation, that a large proportion of deep well turbine equipment is operating at so low an overall efficiency that its replacement is warranted. On a recent investigation of a water supply which had three deep wells in the Chicago area, efficiency tests showed that all three pumping units had over-all efficiencies of less than 50 per cent. One unit, having a 1,000 gpm. delivery at a 140-ft. head, and testing 43 per cent efficient, was removed from the well for inspection. It was found that the pump was badly worn and that some of the shaft bearings and column protector pipe were in poor condition. The defective bearings, shafting and pipe were replaced and new pump bowls purchased, involving a total expenditure of approximately $1,100. The saving in power due to the more efficient unit amounted to about $950 per year, sufficient to pay about 85 per cent annual return on the investment in the new unit. It would have been possible to purchase a new set of bronze pump bowls without the shafting and pipe for this unit for $535, and to increase the over-all efficiency from 43 to 68 per cent. The cost of the new bowls alone would have been fully recovered in about eight months' operation with the higher efficiency unit.

The pump bowls in at least one of the other wells are scheduled for replacement the next time the pump is pulled for any reason. In the meantime, the new, more economical unit is performing the major part of the pumping.

In another northern Illinois city two deep well 600-gpm. turbines, operating at approximately 250-ft. head, were recently tested. The wire-to-water efficiencies were 40.6 and 37.2 per cent, respectively. One of these units is now being replaced with an entirely new 1,000-gpm. unit with a guaranteed over-all efficiency of 67.5 per cent. The total cost of the motor, pump and 300 ft. of discharge column and shafting was $7,100. The saving in power will pay for the entire cost of this unit in a little over two years' time. The old unit is being rehabilitated for use as a spare.

As a check on the efficiency of operation of deep well turbines, it may be stated that the average deep well turbine installation should use somewhere between 450 and 500 kwhr. per mil.gal. pumped 100 ft. higher. Each 5 per cent loss in efficiency, with power purchased at 1c per kwhr. and assuming substantially continu-

*A paper presented before the Illinois section of the Amer. Water Works Assn. and published here by permission of the Association.

ous operation, will cost approximately $150 per year per million gallons pumped 100 ft. high. The correction of but a 5 per cent loss in efficiency will usually pay at least 25 per cent return on the cost of new bowls or the rehabilitation of the old equipment.

From the above, the following conclusions are indicated:

1. All deep well turbines should be frequently checked for wire-to-water efficiency.
2. Every deep well turbine should be carefully tested for efficiency prior to pulling the pump for inspection or other purpose.
3. Every deep well turbine installation should be so piped and wired that the water delivered and energy used can be measured on the individual installation.
4. Every deep well turbine installation should be provided with means of measuring water levels. These measurements should be made at frequent intervals and the data recorded.
5. Whenever the wire-to-water efficiency falls below 60 to 65 per cent it will usually pay to overhaul or replace the pump bowls if the unit is operated any large proportion of the time.

TABLE I

gpm.	Approx. Over-all Eff., %	Annual Cost of Power @ 1c/kwhr. Operating 75% of Time	Approx. Price of Pump and Coupling for 200-Ft. Head	Annual Cost of 5% Loss in Eff. @ 1c/kwhr.	Annual Power Saving as % Return on Cost of New Pump and Coupling
700	65	$ 2,600	$ 370	$ 200	55
1,400	70	4,920	470	350	74
2,100	73	7,100	600	485	81
2,800	76	9,000	750	590	79
3,500	78	11,000	900	700	76
4,200	79	13,000	1,050	830	79
4,900	79	15,300	1,550	960	62
5,600	79	17,500	1,800	1,100	61
6,300	80	19,400	1,900	1,200	63
7,000	80	21,500	2,050	1,345	65

Horizontal Centrifugals

The observations made with respect to deep well turbines apply equally well, although usually with somewhat less force, to horizontal motor-driven centrifugal pumps. Certainly any centrifugal pump, which has been in continuous service for more than ten years and which is being used for "base load," is under suspicion as being uneconomic unless shown otherwise by test.

Table 1 shows the approximate over-all efficiencies which it is practicable to obtain with modern pumps of this type when operating against a 200-ft. head.

As compared to the above efficiencies four centrifugal units averaging 1.5 mgd. in capacity, which were recently tested in an Illinois water plant, had over-all efficiencies of 55.2, 41.3, 46.5 and 49.7 per cent respectively. The 55.2 per cent efficiency unit was of course the one most used. By installing one complete new unit of high efficiency, at a cost of less than $2,000 for motor and pump, to do most of the pumping, and by retaining the other inefficient units for reserve, it was possible to reduce the power cost by $600 per year, a 30 per cent return on the investment.

In general it can be stated that any centrifugal pump with a capacity of more than 4 mgd., which is performing with less than 70 per cent over-all efficiency, is uneconomical and should be repaired or replaced if the pump is to remain in continuous service. Complete new pumps and motors in sizes up to 10 mgd. and normal operating heads are available at a cost averaging about $500 per mil.gal. pumped 100 ft high. A new pump and motor will earn approximately 15 per cent on the investment as compared to an old unit that is 5 per cent less efficient. Assuming that the motor can be used, and only the pump discarded (which is usually practicable), the money expended for the pump alone would produce approximately 50 to 75 per cent return by operating at only 5 per cent better efficiency than the old pump.

In general, any pump in the 1- to 3-mgd. capacity range is uneconomic for regular service if its over-all operating efficiency is less than 60 to 65 per cent or, expressed in another way, if it uses more than 500 kwhr. per mil.gal. pumped 100 ft. high.

Similarly, any pumping unit in the 6- to 10-mgd. capacity range, which is in regular service and which is operating at less than 70 to 75 per cent over-all efficiency, or approximately 475 kwhr. per mil.gal. 100 ft. high, is uneconomic.

The above statements do not mean that all equipment of low efficiency should be replaced. Such equipment is substantially as good as the more efficient equipment if operated only on peak or fire requirements. Its replacement is justified only when operated enough hours so that the saving in power used exceeds the interest and depreciation on the cost of the new unit. If its use becomes relatively continuous a smaller loss in efficiency will finance the replacement. Expressed in another way, if base-load pumping units of high efficiency are maintained, the less efficient units can usually be economically retained as reserve units for long periods.

Meter Reading

There is a wide range in the costs of meter reading in water works systems. The general average cost of meter reading varies between 5c and 7c per reading. There are many instances where the cost in cities using outside settings is as low as 3c and occasionally one is found where the cost is as high as 13c. A well-operated private plant in a southern city has averaged 1.8c per reading over the last five years. In that plant two meter readers, each with an assistant to remove and replace meter box covers, read 18,500 meters each month—an exceptional performance. The difference seems to lie partly in the amount of gossip the meter reader dispenses and accumulates along the route. The manager of one large operating company advised that the principal difficulty that his company experienced in employing girl meter readers was the time lost through gossiping with the consumers and in negotiating "refreshments" offered to them. He reported that this was eventually corrected by bonus incentives for increased number of readings and decreased errors in reading. Meter reading is essentially "piecework" on which careful route-planning and study can set a standard for each system.

Billing

The handling of billing and collections, assuming an average use of modern accounting equipment, should be done with one employee for each 1,000 bills more or less per month. Some systems handle double this number per employee. In the system cited above for its meter reading performance, a force of seven girls handle the billing and accounting for the 18,500 monthly accounts, an average of 2,650 bills per employee.

Hydrant Repairs

Analysis of the records of a considerable number of cities discloses that the annual expenditure for hydrant repairs will vary from $1.75 to $4.00 per hydrant, with the general average about $2.50. In one city, where there was a nine-year average cost of hydrant maintenance of $8.05 per

year per hydrant, investigations showed that the use of hydrant wrenches was substantially unrestricted. Every street employee, fireman, contractor, street flusher and many others had a wrench and used it freely. Further analysis showed that in this city there was an annual replacement equivalent to 70 hydrants for each 10,000 installed, as compared to a general average figure of 25 to 35. Bad practice regarding usage of hydrants adversely affected both the annual maintenance cost and the life of the hydrants.

Meters

The big difference in unaccounted-for water recorded by municipalities is believed to be most largely due to: (1) the character of meter maintenance, and (2) the sizing of meters.

In the normal city, with meters properly proportioned to the service, over 99 per cent of all meters are 1 in. and under. Recently, in a comparatively small, wholly residential town, where an investigation disclosed more than 30 per cent of the pumpage unaccounted for, it was found that the size of meter was determined either by the size of the service or the customer's request. There was no graduated scale in minimum charges. It was found that 2.5 per cent of all meters were larger than 1 in. and that 6 per cent of the meters were 1 in. or larger. Illustrative of the laxity in meter sizing and its effect upon unaccounted-for water is a fountain in the municipal building which continuously runs at a rate of more than 1 gpm. The municipal building was served through a 2-in. meter which failed to register this amount flowing through the fountain and which began to register only when another fixture was opened to nearly full flow. This 2-in. meter was replaced by a 1-in. and in the first month it recorded 30,000 gal. more than the 2-in. meter had been registering.

Investigation further disclosed that there were many 2-in. meters on lawn "gang sprinkler" installations which were rarely used but which allowed the normal household requirements to slip by without registration. One residence even had a 3-in. meter and there were many 1½- and 2-in. meters on residences. It was found that the 1½-in. meters averaged two-thirds more water registration than the 2-in. meters.

Obviously where there are large seasonal requirements there should be two meters—one a small household meter and the other for large requirements — each bearing its proper minimum or service charge.

Meter Registration

It has been ascertained that from 12 to 15 per cent of all water used is at rates of 0.25 gpm. or less. Kuranz[1] found that only about eleven of the 52 cities tested their new meters on a flow as low as 0.25 gpm. Observations made by the author[2] showed that of 221 meters tested in eight different plants, 53 meters selected from service at random failed to register at all when tested at a rate of 100 gpd., and 44 more registered less than 50 per cent of the water passing through them at that rate. In one city in which the unaccounted-for water was 42 per cent, not a single meter of twelve tested registered at 100 gpd. It is the author's opinion that meter testing is scarcely worth doing at all unless the meters are adjusted to catch flows of 0.25 gpm. or less.

Meter Repair Costs

The frequency of meter repairs and the procedure by which meters to be tested are selected vary widely in different cities, presumably reflecting the experience of the various cities and the variations in waters. In the records of ten cities recently studied, an average of 12 per cent of the total number of meters was repaired each year. That would indicate a general average of a meter being thoroughly overhauled once in eight years. The weighted average cost of meter repairs in seven of these cities for which the costs were available was approximately $1.70 per meter based upon approximately 25,000 meters repaired.

In a recent check on a small private water company in which 484 meters were tested, the average over-all cost was $1.26 per meter, divided equally between labor and materials.

Kuranz[1] records figures from approximately 50 plants from which it is computed that the average time for meter repairs in 42 cities was one hour and 24 minutes and the average cost of repair parts 31c. Deducting this 31c from the total for labor and materials of $1.70 above referred to would leave $1.39 as the labor cost. This $1.39 spread over Kuranz' average time of one hour 24 minutes per meter would give a

TABLE 2
Condensed Monthly Operating Statement
September 1945

Item	September 1944	September 1945	Totals to September 30 1944	Totals to September 30 1945
Water Revenue				
Residential Metered				
Commercial Metered				
Industrial Metered				
Municipal Metered				
Public Fire Hydrants				
Private Fire Hydrants				
Sprinkler System				
Total Water Revenue				
Water Operating Expense				
Operations				
Source of Supply				
Electric Power Purchased				
Steam Pumping				
Purification				
Total Production Expense				
Transmission and Distribution				
Commercial Expense				
General Expense				
Total Water Operating Expense				
Maintenance Expense				
Pumping				
Purification				
Total Production Maintenance				
Transmission and Distribution Expense				
General				
Total Maintenance Expense				
Total Operating and Maintenance Expense				
Taxes other than Income				
Total Water Expense				
Operating Income				
Operating Statistics				
Mil. Gal. Pumped to Mains				
Mil. Gal. Metered				
Mil. Gal. Not Metered				
% Unmetered to Pumpage				
Number of Consumers				

In a recent check on a small private water company in which 484 meters were tested, the average over-all cost was $1.26 per meter, divided equally between labor and materials.

Kuranz[1] records figures from approximately 50 plants from which it is computed that the average time for meter repairs in 42 cities was one hour and 24 minutes and the average cost of repair parts 31c. Deducting this 31c from the total for labor and materials of $1.70 above referred to would leave $1.39 as the labor cost. This $1.39 spread over Kuranz' average time of one hour 24 minutes per meter would give a

labor rate of $1.00 per hour, indicating a good agreement in the data.

Repairing meters to catch small flows pays dividends. The city accounting for but 58 per cent of its pumpage fifteen years ago (previously referred to) has 30,000 meters. Last year it was paid for 89 per cent of the pumpage—adjusting meters so as to catch small flows was the principal difference. In a single year in another city the meters in one-third the system (about 15,000 total) were tested and adjusted to catch small flows. The results were so impressive that the other two-thirds were then similarly adjusted. That city now gets paid for 90 to 92 per cent of the pumpage. From the above it is concluded that:

1. It is usually practicable to measure and receive payment for 85 per cent or more of the pumpage.

2. The principal factors in reducing "Unaccounted-for water" are believed to be improved meter repair and meter adjustment to catch low flows.

3. Every meter that comes to the shop should be adjusted so as to register accurately all flows at least as low as 0.25 gpm.

4. The average cost of meter repairs is probably between $1.25 and $1.75 per meter. Assuming that as an average 12 per cent of the meters are repaired per year, this is equivalent to from 15c to 25c per year when spread over the total number of meters installed.

5. The total cost of operation and maintenance of more than 500,000 meters in a number of larger cities for which records are available is approximately 50c per meter. This includes routine testing, cleaning and maintenance, as well as repairs.

6. Proper sizing of meters is important. This should be determined solely by the utility.

7. Service or minimum charges should be so graduated as to make over-sizing unattractive to the water consumer.

Car and Truck Operation

There is a wide divergence in the use of cars on various water works systems. It would appear that this use, if properly regulated, should be a reflection of the mileage of mains in the system and the population served.

L. A. Geupel[3] submitted data regarding automobile use in 22 cities with populations varying from 100,000 to 200,000. The average population was approximately 140,000. The average number of cars and trucks in these systems was 27 per system or a weighted average ratio of one car per 5,300 population. The average miles operated per year per 1,000 population was 1,870.

An analysis made in the author's office of fifteen cities varying in population from 225,000 to 1,000,000 showed a weighted average of 8,000 population per car and an average mileage of 1,120 per year per 1,000 population. In one city which was investigated in detail, there were substantially no restrictions on the use of cars and all cars were stored in the private garages of the men using them. In this city there was an average of one car for each 4,500 people and the average mileage per 1,000 population was 2,860; the annual mileage per mile of main was 1,310, a figure two and one-half times the general average; the average annual cost per mile of main was $83.50, as compared to a general average of $28.20; and the annual cost per capita was 18c, as compared to a general average of 6c.

In general it is believed that a reasonable mileage for cars and trucks in a water works system is best indicated by the mileage of mains which they are called on to service and a general figure of 500 miles of travel per year per mile of mains in the distribution system is reasonable of attainment.

Distribution System Operation and Maintenance

This item, excluding services and meters, is primarily a reflection of the mileage of mains in the system and the size of the mains, although if there is a large amount of material other than cast iron it may also be affected thereby. In general, the cost of distribution, system operation and maintenance, exclusive of services and meters, in well-maintained systems averages about $12 per inch diameter per mile of pipe per year.

Operating Records

Every water utility should have a standard form of report. This report should be prepared monthly so as to show current costs and efficiency in comparison with those of the corresponding month of the previous year. The annual report does not serve this purpose adequately. The post mortem review of operations, too long dead, which it records, simply embalms inefficiency, the correction of which requires prompt knowledge of its existence.

An example of what is believed to be a minimum in monthly reports is shown in Table 2. This is usually expanded to show details.

Municipal utilities would benefit, as those privately owned have benefited, from the adoption of the Standard Classification of Accounts prescribed by the National Association of Railway and Utility Commissioners.

Conclusions

The foregoing illustrates some of the checks which can be readily applied to the ordinary water works operations. It is hoped that those who read this discussion will be moved to analyze their own operations, compare them with these very general standards, and establish "par" for each operation in their own plants.

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APWA Reaches Conclusions on Water and Sewage Works at Chicago

At the 1945 Public Works Congress held in Chicago, the round table discussion on water and sewage works was led by Darwin W. Townsend of Consoer, Townsend and Quinlan, Consulting Engineers, Chicago.

Among the conclusions reached at this round table discussion were (1) that no chlorine shortage actually exists, but that supply problems are aggravated by tank car shortages and other transportation difficulties; (2) to date there has been erratic bidding on the small amount of water and sewage works expansion on which bids have been opened, and prices are in the neighborhood of 40 to 50 per cent higher than in 1940-41; (3) war developments affecting water and sewage works are still too uncertain to admit of any conclusions; (4) municipalities must consider the advisability of raising salaries and improving work conditions in order to maintain competent operating and maintenance personnel.

VIRGINIA SECTION MEETING

Back to Prewar Form at Hotel Roanoke

Chairmen

(Outgoing) *P. H. McGauhey, Prof. San. Eng., V. P. I. Blacksburg, Va.*

(Incoming) *W. B. Harman Ass't Gen'l Mgr., Water Comm. Newport News, Va.*

Finding that it would be necessary to prune down this report of the Virginia Section's meeting considerably if it was to run in our December issue, or else hold it out for this issue, the latter choice seemed the more desirable. Therefore, by delaying publication one month we are able to give a much more deserving account of the splendid meeting of the Virginia Section, with the full complement of pictures taken during the meeting. We offer this explanation for the delayed appearance of this report to members of the Section and all others concerned.

Vice-Chairman *X. D. Murden, Supt. Water, Portsmouth, Va.*

Sec'y-Treas. *W. H. Shewbridge, State Dept. Health, Richmond, Va.*

THE 12th Annual Conference of the Virginia Section of AWWA, held November 8th and 9th at Hotel Roanoke in Roanoke, Va., took on prewar form, reminiscent of the many splendid meetings which the Virginians have staged at this ideally suited hostelry. From atmosphere and fine food to comfortable meeting facilities, Hotel Roanoke strikes this writer as a spot unexcelled for the holding of conferences and small conventions. And let this be an invitation to out-of-staters to enjoy an experience of touring "Old Virginny" and attending the next meeting of the Old Dominion Section to be held in Roanoke. Since the meetings are held in Richmond and Roanoke on alternate years, this will probably be in 1947. And this is not to say that the Richmond meetings aren't worthy of attending also, and there is plenty of historic interest in the home of Patrick Henry and other great men, the capital of the Confederacy and in nearby Williamsburg.

It takes two things to make successful meetings—one is a good program, and the other is a hotel with proper facilities. This year the Virginia Section had both. Oh yes, we might have added a third ingredient in our successful meeting formula—namely, quality of entertainment. And this leads to comment on the high quality of entertainment provided, largely through the efforts of the Chairman of the Ladies Entertainment Committee, Mrs. Lucien Crockett, aided by Roanoke's Mrs. Charlie Moore and Mrs. Phil Kavanagh. The annual dinner served by Hotel Roanoke was of a quality to long remain in the minds of many of us conventioneers who have numerous of these annual dinners of very variable quality to eat. Then following this really enjoyable repast, the audience was treated to a floor show wholly composed of Roanoke's local talent, including some of the children of Virginia Section members, to add interest beyond that of the mere watching of a performance. If this be taken as a suggestion to other sections, let it be, for next to performances by fellow members, the most overall satisfying entertainment provided for sectional meetings seems to be local talent, if this writer is any judge.

Director Elect* *Chas. E. Moore, Gen'l Manager, Water Dep't, Roanoke, Va.*

Fuller Awardee *Lucien Crockett, Chief Chemist, N. & W. Ry., Roanoke, Va.*

**To succeed Major R. Messer at close of 1946 AWWA convention.*

Fuller Award to Crockett

The George W. Fuller Memorial Award of 1945 was voted to Lucien P. Crockett, Chief Chemist for the Norfolk and Western Ry., Roanoke, Va. Mr. Crockett, a past-chairman of the section, was cited for his long continued interest in the section and services thereto as well as his abilities as supervisor of water supplies and chief chemist of one of America's important railway systems. His speech of acceptance was one of the best impromptu speeches of the kind ever heard to come from a man so speechless at first as the result of surprise.

Eugene F. Dugger Gen'l Manager, Water Works Comm., Newport News, Va. (Mrs. Dugger)

Wendell R. LaDue Supt. Dep't Water and Sewerage, Akron, Ohio (Mrs. LaDue) *Vice-President, AWWA*

"Al" Brumley, V.P., Stuart-Brumley Corp., Baltimore, Md. (Mrs. Brumley)

Major Richard Messer, Ch. Engr., Va. State Dep't Health, Richmond, Va. (Mrs. Messer)

"Mike" J. Siebert, District Mg'r, Neptune Meters, Richmond, Va. (Mrs. Siebert)

Officers Elected

Eugene F. Dugger of Newport News, Va. (a past-president of AWWA) presented the following slate as chairman of the Nominating Committee. The election was unanimous.

Chairman

W. B. Harmon, Ass't Gen. Mgr., Water Supply Commission, Newport News, Va.

Vice-Chairman

X. D. Murden, Supt., Water Dept., Portsmouth, Va.

Secretary-Treasurer

W. H. Shewbridge, Ass't San. Engr., Va. State Dept. of Health, Richmond, Va.

Trustees

M. J. Siebert, Neptune Meter Co., Richmond, and H. E. Silcox, C. & O. Ry., Richmond.

*AWWA Director**

Chas. E. Moore, Gen. Mgr., Roanoke, Va., Water Works.

PAPERS AND DISCUSSIONS

The technical sessions were opened with an informal speech of considerable interest and excellent delivery by Virginia's Highway Commissioner and Engineer, General Jas. A. Anderson of Richmond.

The General in a straight from the shoulder talk made it plain that the present period of high labor cost and prosperity was no time to start work on planned post war construction of public works of any sort. He emphasized the point, however, that this did not mean that public works plans should not be at the stage of readiness to go—i.e., ready up to the point of advertising for bids. He told Virginians to watch the growth and expansion of present industrial plants in the state and to expect the location of new industry in Virginia, amongst which will be du Pont at Martinsville, Va., and Am. Viscose at Radford. Such industrial growth constituted real reasons for expanded water supply and sewerage disposal facilities in Virginia. He indicated the admitted *possibility* of Federal aid for water and sewage betterments but thought that many would be disappointed if waiting for such aid, which did not appear to be a *probability*, but rather the opposite, in view of the great Federal debt and the splendid financial status of municipalities in general. His forthright talk was highly complimented from the floor and the General answered all questions without in the least hedging. He lamented the fact that the services were holding on to young engineers so long, when badly needed to complete post war plans and supervise construction later.

"Major Water Supply Betterment for Roanoke," by Louis H. Howson, Consulting Engineer, Chicago, Ill.

Mr. Howson's paper described briefly the present water supply facilities of Roanoke and the new project under construction which will add 6.8 mgd. of soft mountain water (20 ppm. hardness) as a filtered gravity supply. At present the supply of Roanoke from three limestone springs (one yielding safely 4 mgd.) and a 1.5 mgd. yield soft impounded supply barely meets the average summer demand of 6 mgd. and an estimated demand of 9 mgd. by 1960 which is anticipated because of the interest of industry in the new and abundant soft water supply.

It is predicted that the 18 sq. mile Carvin's Cove watershed area will safely yield 10 mgd., and this can be supplemented in the future by tunneling through to adjacent watersheds. The gravity supply from the distant Carvin's Cove reservoir was chosen over the Roanoke River, which runs through the city, even though it entailed a higher initial cost and

Roanoke's 6 MGD. Carvin's Cove Filter Plant

(Architect's conception of Colonial design for this early post war plant in the Blue Ridge Mountains of "Ole Virginny," recently put under construction.)

*Director-Elect. To succeed Major Richard Messer at the close of the 1946 Convention in St. Louis, Mo.

"Al" P. Rudder, W. & T. Co., Washington, D. C. | *Harry A. Ballance, Va. Smelting Co., W. Norfolk, Va.* | *Charlie Johnson, Sup't of Water, Salem, Va.* | *"Bert" H. Snyder, W. & T. Co., Arlington, Va.* | *Ed. R. Sharp, Distrib. Sup't Richmond, Va.* | *Stanley Kappe, Mf'rs Rep., Washington, D. C.* | *Ralph Kelley, Northrop & Co., New York, N. Y.*

greater annual charge by $15,200 per year than the river supply. One reason for this is the fact that the river water of 148 average hardness would require softening. Furthermore the river carries an appreciable industrial waste load from nearby Salem in addition to sewage. A major reason was that Roanoke had already invested about $600,000 in the Carvin's Cove dam and purchase of reservoir areas. The total estimated cost for the Carvin's Cove supply delivered to the distribution system is $1,908,242, with annual charges of $149,600, as compared to the Roanoke River project at only $712,000 and annual charges of $134,400.

The filter plant will operate wholly by gravity until the reservoir level drops to 12 ft. below the spillway, when the safe yield will be 8.5 mgd. as compared to 10 mgd. with a full reservoir. The nominal capacity of the plant is 6 mgd. at 2 gal. per sq. ft. filtering rate, but is designed to operate at a 3 gal. per sq. ft. rate to supply 9 mgd. if and when required. A 2 mg. clear well at the plant will serve as a balancing reservoir feeding into the city through a 7 mile 36 in. supply line. A 3,100 ft. 36 in. main delivers raw water from the dam to the filter plant, with provisions made for a booster pump installation if and when such becomes necessary. A unique feature of the plant design is that the pipe gallery with two filters on each side carries relatively little piping because both the influent and the wash water lines enter the filters from the rear.

On the distribution system of Roanoke there is to be storage of 2 mg. at essentially each of the four corners of the system, involving construction of a new 2 mg. reservoir in the S. W. district, a new 2 mg. standpipe in the N. W. district, enlarging the existing Mill Mtn. reservoir in the S. E. district to 2 mg., while the clear well at the filter plant supplies 2 mg. storage for the N. E. district.

Mr. Howson displayed an intriguing set of curves revealing economic studies in selecting the 36 in. size for the 7 mile supply line from the filter plant to the city. To eliminate pumping during peak demand periods the 36 in. main was chosen over a possible smaller size and intermittent or seasonal booster pumping. Alternate bids taken on bituminous enamel lined and paper wrapped steel pipe, cement lined cast-iron, and prestressed concrete pipe showed the concrete pipe bid of $378,411 to be $42,300 under wrapped steel which was next lowest. The successful bidder was Lock Joint Pipe Co. of Ampere, N. J.

Concerning bids on construction and pipe laying, Mr. Howson reported that in August, 1945, because of labor cost uncertainties only two bidders responded to the call. In September bids were again called for and with persuasion six bidders were secured for the filter plant and pipe laying. Pipe laying bids ranged from $637,742 to $658,704, which proved to be 50 to 75 per cent higher than anticipated. Bids on equipment, on the other hand, were only slightly higher than anticipated and in many instances no higher. To date bids to the amount of $1,776,279 have been let. An interesting disclosure was the cost of $60,000 for providing a concrete cover over the existing 2 mg. reservoir as compared to only $52,000 for the complete new 2 mg. steel standpipe.

Harry E. Jordan at this point commented on the status of water supply planning. At its present stage of development, surveys reveal that of all construction, water supply improvements normally constitute one-

Mrs. "Bert" Snyder, Arlington, Va.

and

Mrs. "Fred" Dimmick, Richmond, Va.

E. M. Jones, Sales Mg'r, Simplex Meter Co., Philadelphia

(Mrs. Jones)

Mrs. P. H. McGauhey, (Just a Convention Chm'n's Widow.) Mrs. Lucien Crockett, (Chm'n Ladies' Entertainment.)

Howard Johnson, Sup't Filtration, Danville, Va. (Mrs. Johnson)

Cecil G. Haney, Devel. Engr., Stuart-Brumley Corp. (Mrs. Haney)

X. D. Murden, Sup't of Water, Portsmouth, Va. (Mrs. Murden)

Chris. F. Bingham, Sales Manager, Va. Smelting Co. (Mrs. Chris. B.)

"Bob" W. Fitzgerald, Sup't of Water, Norfolk, Va. (Mrs. Fitzgerald)

sixteenth of the total dollar value in construction, whereas planned water supply improvements as of today constitute 20 per cent of the total. However, the weak point is that only about 7 per cent of the total water supply plans are ready for letting of contracts. None the less, water and sewage in the planning stages stand at three times the normal ratio to total construction measured in terms of anticipated expenditures.

"Milestones Along the Road in Taste and Odor Control" by W. A. Welch, Industrial Chemical Sales Div., West Va. Pulp and Paper Co., New York City.

Mr. Welch traced water quality and the acceptance by the public in years gone by of water quality which would not be tolerated today. Realizing that pure air and pure water have no odor or taste, the public is no longer content with anything less than tasteless and odorless water. Only since the mid-1920's have water works operators had the requisite methods and tools for taking tastes and odors out of water. For a time this "tool" appeared to be granular carbon absorption beds. Then came along the simpler and more economical method of using powdered carbon ahead of the filters. By 1930 the method had been proven effective and thereafter followed a decade of rapid adoption of carbon treatment which enjoyed a mushroom growth. The literature as well as the water supply of the nation became filled with carbon. The treatment ran "hit or miss" fashion until the development of the "Threshold Odor" evaluation in dosage control occurred, to constitute the first measuring stick in determining need for treatment, efficiency of treatment and economical usage of carbon. The test is more refined and delicate than the water consumer's nose. The acceptable water will have no noticeable odor when diluted in equal volume with an odor free water and warmed to 65° F. The T. O. number is referred to as 2. At lower temperatures the T. O. number becomes even lower and the public will not notice any taste. Mr. Welch, however, commented that the nature or quality of odor will frequently determine the acceptable T. O. number, so the rule of T. O. = 2 does not apply universally and some odors may go to a T. O. of 6 before proving objectionable. More often than not, however, a T. O. value of 2 is the safer point of operation.

As to the initial *intensity* of odor, this seems to have little to do with establishing the dosage of carbon required. The nature or *quality* of the odor is the important factor and some odors require several times the carbon dosage of others. The point of application and effectiveness of distribution, as well as the characteristics of the carbon, all enter the picture in most instances.

In using carbon the "law of diminishing returns" applies. That is to say that one-tenth of the optimum dosage may reduce odors by 50 per cent or more, whereas reduction to a threshold odor value of 2 requires several times as much carbon. In such instances a change in the quality of carbon employed may solve the economic as well as the technical problem.

"Defining Chlorination Terms" by R. C. Clement, Div. Mgr., Wallace & Tiernan Co., Newark, N. J.

Mr. Clement's paper was very similar to a paper of a similar title by A. E. Griffin, which has been covered in the report covering the N. C. Section meeting in our last issue. After defining pre-chlorination, post-chlorination and super-chlorination, he defined "marginal" chlorination the practice of chlorination which results in securing a positive test for residual chlorine without attempting to determine in what form the apparent chlorine residual is. Such chlorination is in the zone of greatest potential danger of taste production. "Break-point" chlorination was defined as that degree of chlorination which leaves a residual consisting almost wholly of chlorine in the oxidizing form—such as hypochlorous acid (HOCl). When this condition has been established, taste and odor producing bodies are destroyed and ammonia is dissipated almost completely. In the orthotolidin test for residual chlorine the full color develops instantaneously, indicating the absence of chloramines, which require up to 5 minutes for full color development.

Mr. Clement gave the procedure for preparing water of zero chlorine demand as the addition of chlorine to produce 1.5 ppm. residual and standing this water in sunlight until all residual has disappeared as the result of conversion of "free chlorine" to oxygen and chlorides.

H. E. Jordan, as in the case of the earlier use of the term "marginal chlorination" in the North Carolina paper, objected to this term as indicative of chlorination of a border-line nature. Since the type of chlorination now considered "marginal" has been practiced with good results over a long period, he could not accept "marginal" as a fair description and suggested "basic chlorination" or "simple chlorination" as more truly representative.

K. P. Bell, San. Engr., Dept. of Health, Washington, D. C., reported a surprising result from heavy super-chlorination on the Washington distribution system. In giving this water supplementary chlorination in a transmission main no "break-point" had been detected. However, the "flash test" had indicated a lot. This super-chlorination had been providing 1 to 10 ppm. flash residual at the customer's tap without a complaint. Prior to this eye-opening treatment taste complaints from the section of the system had been prevalent and gas formers appeared in 80 per cent of the samples. Although the control had been rather loose, the results had been all that is desired so long as the chlorine dosage is maintained above the flash test.

"The Revised U. S. P. H. S. Standards for Drinking Water" by J. K. Hoskins, Chief of Sanitary Engineering Div., U. S. Public Health Service, Washington, D. C.

Mr. Hoskins' paper, presented by V. G. MacKenzie of Mr. Hoskins' staff constituted a review of the modifications made to the existing U. S. P. H. S. Drinking Water Standards, with the objective of improving the standards which will issue as the 1946 Standards for Drinking Water. All changes requested by the Am. Water Works Assn. had been made in order that the standards could be endorsed by AWWA as National Standards for *all* water supplies, rather than their more limited application to supplies used on common carriers. Mr. MacKenzie went over the changes made in some detail to assure AWWA members that all requested changes had been made and others in addition. The so-called manual appended to the 1942 Standards is being dropped until a new manual can be developed for independent publication.

[Ed. Note—Since this was written the AWWA Board of Directors has officially accepted the revised 1946 Standards for Drinking Water as applicable to *all* public water supplies and these standards now become National Standards.—L. H. E.]

PROBLEMS OF THE RECONVERSION PERIOD

Harry E. Jordan, Exec. Secy. of AWWA, in a discussion of the problems of the reconversion period in water supply, urged water works

Alan Wood, Luther & Wood, Washington and "Rollie" J. LeVeque, Sales Manager, Omega Mach. Co., Providence, R. I.

Richard Hazen Lieut. Commander, C. E. Corps, U. S. Navy and Harry E. Jordan, Exec. Sec'y, AWWA.

Chas. E. Moore, General Manager, Water Dep't, Roanoke, Va. and Louis R. Howson, Cons. Engineer, Chicago

R. C. Bardwell, Water Supply Eng'r, C. & O. Ry., and H. E. Silcox, Ass't W. S. Engr., C. & O. Ry., Richmond, Va.

managers to make known to their State Sanitary Engineer or the U. S. Public Health Service any or all materials or equipment which might be needed and possibly obtainable from surplus war property. The aim is to have a representative figure covering materials and equipment likely to be needed by municipalities, which materials can be "frozen" by the Federal Security Adm. for municipal purchase later at a considerable discount.

In raising the question of the wisdom of starting construction work at this juncture, Mr. Jordan pointed out the reticence of contractors to bid in the present non-dependable labor market. Contractors that do bid must bid so high for self-protection that only the most essential construction can be justified.

In discussing postwar personnel problems, Mr. Jordan said that something needed to be done to secure a better understanding and appreciation of services rendered the community by the water utility. Further, some study should be made comparing wages and salaries of water utility employees with those paid by other employers for similar work and responsibilities. From such data wage and salary scales should be developed for the water works employees.

Mr. Jordan directed attention to the matter of developing job classification and salary rates for all municipal employees, such as Lincoln, Neb., has done recently and as Los Angeles has in progress. The end sought is to raise pay levels to those of local industry which, Mr. Jordan pleaded, should be the objective of every utility manager at this time.

Programmers

Whitworth Cotton, City Engineer and Sup't Water, Petersburg, Va. | *R. C. Clement, Div. Mg'r, W. & T. Co., Newark, N. J.* | *H. E. Beckwith District Mg'r, The Pitometer Co., Pittsburgh, Pa.* | *V. G. MacKenzie, Surplus Prop. Ch'f, U. S. P. H. S., Washington.* | *A. P. Bell, San. Engr.-Ch'mist. Distr. of Columbia Dep't of Health*

"Water Waste Surveys" by H. E. Beckwith, Distr. Mgr., The Pitometer Co., Pittsburgh, Pa.

Mr. Beckwith described the several operations involved in making a complete water waste survey of distribution systems. These included (1) pump testing for slip, efficiency, etc., (2) checking of all master meters, (3) measuring flow into various sections of the system between midnight and 5 a. m., and reading industrial meters at the same time, (4) testing industrial meters in place and checking fire lines for unauthorized flow, (5) locating leaks with sound instruments and auxiliary methods.

Mr. Beckwith then described the various instruments which have been found most useful in waste detection and leak location. Amongst these were the modern pipe locators. The danger of depending on sound instruments in leak location is the fact that the largest leaks make little if any sound.

Mr. Beckwith, in discussing what the reasonable figure for accounted for water should be, pointed out the interesting fact that the strictly domestic system will always show a poorer record than a system with considerable industrial customers. For instance, a system showing 90 per cent water accounted for through meters may overnight show only 60 per cent accounted for if industrial use ceases. Likewise, the lower the metered consumption per capita the lower will be the accounted for water figure.

"Water Main Cleaning Experiences" by Whitworth Cotten, City Engineer, Petersburg, Va.

H. C. Jones, Sup't Filtration Dan River Mills, Danville, Va. and H. M. Rexrode, Devel. Eng'r, Phipps & Bird Co., Richmond, Va.

H. E. Lordley, Sup't Filtration Richmond, Va. and "Phil" Kavanagh, Distr. Mgr., W. & T. Co., Roanoke, Va.

Frank C. Harmstad, Sales Manager, "Fred" Dimmick, District Manager, R. D. Wood Co., and Fontaine Jones, Dep't of Utilities, Richmond, Va.

Ralph B. Carter III, and L. W. Klockner, Ralph B. Carter Co., Hackensack, N. J.

W. S. Meyers, City Engineer, Harrisonburg, Va. and L. J. Stockner, Sup't of Water & Sewerage, Galax, Va.

Mr. Cotten presented some interesting figures on pipe lines of various ages and size showing the variable depreciation in delivery capacity as the result of tuberculation in various degrees, revealed by photographic record and flow measurements in a Pitometer Co. survey which resulted in a main cleaning program. This program, which involves a schedule of recurring cleaning over an 8 year period to spread costs, is described in Mr. Cotten's paper printed in full elsewhere in this same issue. To retard tuberculation of the cleaned mains, lime is being added to the water with dosage control provided through use of an Enslow Stability Indicator. The pH of the unstabilized water ranges from 5.8 to 6.7 and the stabilized water from 8.6 to 9.3, as indicated by the Stability Indicator readings. Carbonate hardness is increased by 10 to 15 parts to secure the indicated pH values.

Municipalities and Surplus War Property

Commander V. G. MacKenzie, who had just been made Surplus Property Chief in the U. S. Public Health Service, explained the more recent Regulation 2, which permits the freezing of types of surplus materials and equipment which may be needed by municipalities, such material to be sold at substantial discounts by the War Surplus Administration.

Mr. MacKenzie explained that his immediate job was to prepare an estimate of materials which municipalities should require in water, sewage and public health for the purpose of getting such materials earmarked or frozen. He therefore suggested that water and sewage works managers file their needs with the State Health Dept. or the U. S. Public Health Service.

"The Question Box"

During the Question Box hour at the close of the meeting the following were amongst the interesting disclosures.

Water does not become stale in large reservoirs. Limestone contact beds were not successful at Roanoke for stabilizing the soft water supply because the contact period was too short.

Answering the question, "Is it practical to attempt softening of a water of 140 parts hardness in a 2 mgd. plant?" L. R. Howson, Cons. Engr. of Chicago, explained that on the average the chemical cost for reducing hardness by 100 ppm. had been about $10 per million. Over and above the cost for a filter plant, softening would add about 15 per cent to the construction cost. To soften the water in question to 80 parts hardness would cost about $6 per mg. for chemicals. If a new plant be required for softening alone, the plant cost would run to about $125,000 for a 2 mgd. plant.

To secure surplus war properties locate the items desired and then notify the USPHS in Washington, attention Surplus Property Div. Discounts available to public bodies will probably be 40 per cent under published ceiling prices. It is highly important to take advantage of surplus property for the interested parties to get their names on the War Surplus Administration's lists so as to keep informed of the availability and location of equipment and materials declared surplus from time to time. The address is War Surplus Administration (Information Div.), Washington 25, D. C.

Florida Section Meeting

We regret that the report covering the meeting of the Florida Section of AWWA, planned for this issue and so announced in our December issue, must be held over for our next issue.

AN INDIRECT METHOD OF DETERMINING POTASSIUM

By GEORGE A. RHAME
Supt. Sewage Treatment
FT. JACKSON, S. C.

DESIRING to determine the potassium content of the digested sludge at the Ft. Jackson, S. C., sewage treatment plant, I took down my "Standard Methods" to line up the necessary chemicals. I was appalled by the long-drawn-out procedure set forth, not to mention the high price of the platinum salts required.

It occurred to me that there must be a definite relation between the amounts of sodium, potassium and chloride in the residue obtained at the end of the standard method procedure—and so there was. Further investigation showed the same general idea in my old text on Quantitative Chemical Analysis. So, the following method was developed as a simple although indirect method of determining the potassium in a sample of water — sewage, sludge or sludge liquor.

Procedure

Determine the total of sodium and potassium chlorides as given in the 8th edition of "Standard Methods." Report as parts per million.

Redissolve the combined sodium and potassium salts in distilled water, making up to the original volume of the sample. Mix thoroughly.

Determine chlorides in the above as given in "Standard Methods."

Then ppm. KCl = 4.6291 × ppm. NaCl:KCl = 7.6330 × ppm. Cl^-

(NaCl:KCl represents the combined salts.)

The formula above was derived as follows. Let—

FK = factor for Cl^- in KCl = 0.47557

FNa = factor for Cl^- in NaCl = 0.60658

Where the chemical symbol appears it stands for ppm. of that chemical present.

The ppm. of mixed salts, NaCl:KCl and of chloride in the mixed salts are known.

Therefore:

$$Cl = FNa \times NaCl + FK \times KCl \qquad \text{Eq. (1)}$$

$$NaCl{:}KCl = NaCl + KCl \qquad \text{Eq. (2)}$$

Multiply Eq. 2 by FNa

$$FNa \times NaCl{:}KCl = FNa \times NaCl + FNa \times KCl \qquad \text{Eq. (3)}$$

Subtract Eq. 3 from Eq. 1

$$Cl - FNa \times NaCl{:}KCl = FK \times KCl - FNa \times KCl \qquad \text{Eq. (4)}$$

Then

$$KCl\ (FK - FNa) = Cl - FNa \times NaCl{:}KCl \qquad \text{Eq. (5)}$$

And

$$KCl = \frac{Cl - FNa \times NaCl{:}KCl}{FK - FNa} \qquad \text{Eq. (6)}$$

Substituting numerical values:

$$KCl = \frac{Cl - 0.60658 \times NaCl{:}KCl}{0.47557 - 0.60658} = \frac{Cl - 0.60658 \times NaCl{:}KCl}{-0.13101}$$

Then

$$KCl = 4.6291 \times NaCl{:}KCl - 7.6330 \times Cl \qquad \text{Eq. (7)}$$

As a slower but more accurate alternate, the redissolved chlorides could be precipitated and weighed as AgCl and sodium and potassium determined by a similar calculation.

[Ed. Note: Dr. M. C. Schwartz, of the Eng. Expt. Sta. of Louisiana State Univ., and a member of The Editorial Board of the 9th Ed. of Standard Methods for Water and Sewerage Examination, has advised that this method is correct and simple although he believes that if there is available "a solution which contains only sodium and potassium as chloride it is preferable to determine potassium directly in this solution."—While we know that few of our readers ever determine potassium we felt this article deserved publication because it shows praiseworthy initiative and application on the part of Mr. Rhame.]

MAIN CLEANING*

By WHITWORTH COTTEN
City Engineer
PETERSBURG, VA.

DUE to the increase in population of Petersburg, resulting from the expansion of nearby Camp Lee, the maximum daily consumption of water has increased about 50 per cent. On days of heavy consumption, severe drops in pressure were observed in a large portion of the distribution system. A check on available fire flows indicated a loss since the last check made by the Underwriters about twenty years ago. Realizing the inadequacy of the system, it was decided to employ a consultant to make a complete study of the city's distribution system, and to make full recommendations as to the present and future needs in order that the city would be provided with a sound program of water works improvements for postwar projects. The Pitometer Company was employed to make this survey and report, and the work was completed in March, 1945. The report recommended a $316,000 improvement program designed to meet the estimated requirements until 1960.

The Author

*A paper presented before the Virginia Section of the Amer. Water Works Assn. and published here by permission of the Association.

Determination of C Values

Part of the work done in this survey was the determination of the Hazen-Williams coefficient *C* of the important feeder mains. The results of some of these tests are shown in the accompanying table.

Item	Size, in.	Date Laid	Actual Coef. C	Hazen-Williams Coef. C
1	16	1897	58	70
2	16	1897	75	70
3†	16	1941*	57	120
4	12	1856	51	45
5	10	1915	45	90
6	12	1917	37	90
7	12	1922	40	90
8	8	1934	70	110

†Raw Water Line.
*Date Cleaned.

It will be noted from the examination of this table that the mains laid in 1856 and 1897 had coefficients approximately equal to those given in the Hazen-Williams tables for pipe of this age; whereas the pipe laid between 1915 and 1934 and the raw water line cleaned in 1941 had coefficients that were approximately one-half the values given in the Hazen-Williams tables. Furthermore, the pipeline shown as No. 4, the oldest in the system and laid in 1856, had a higher coefficient than Nos. 6 and 7, which were laid in 1917 and 1922, respectively, and line No. 4 runs parallel to and between Nos. 6 and 7. Several theories have been advanced for this peculiar condition, such as the difference in the cast iron (the old pipe is much harder to cut), the difference in coatings used and the fact that the source of water was changed in 1913.

The raw water line (No. 3) was laid in 1913, and had a coefficient of 70 in 1941, prior to cleaning. Cleaning restored the coefficient to 125. This was reduced to 110 the first month, and to 57 by 1945.

Because of the low coefficients which existed in the distribution system, the report recommended the cleaning of 96,000 ft. of existing main. This includes 95 per cent of all mains 10 in. and larger, and

Fig. 1. 12-in. Pipe Laid in 1922; C=40, May, 1945

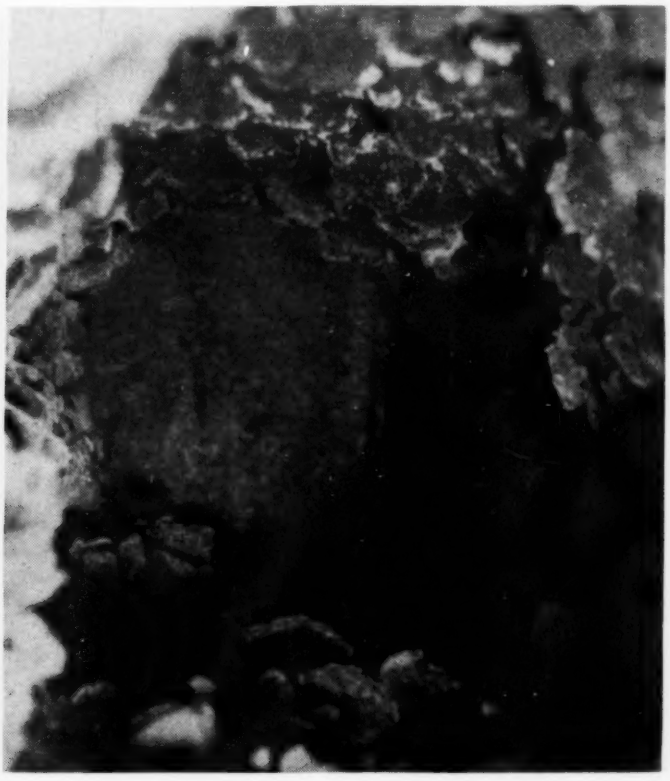

Fig. 2. 12-in. Pipe Laid in 1856; C=51, May, 1945

about 70 per cent of the 8-in. mains in the existing system.

Due to the large amount of cleaning to be done, it was decided to spread the work over a period of about eight years, cleaning approximately 12,000 ft. of main each year. This will spread the cost over a long period. It is also hoped that subsequent cleaning will not be required more often than every eight years. If this does prove to be the cycle required for cleaning, then the cleaning could be maintained by a continuous yearly program. The wisdom of this program must await the test of time.

Cleaning the Mains

In view of the extensive deficiencies indicated from the survey, it was considered necessary to proceed at once with the cleaning of the most critical feeder mains. It was decided that the most good would be accomplished by cleaning the mains shown as Nos. 4, 5, 6 and 7 in the above table. This gave a program totaling 12,000 ft. of 10- and 12-in. main. A contract for this work was let to the National Water Main Cleaning Company and the work was done during April and May.

The first lines cleaned were Nos. 6 and 7, which are 12-in. lines about one-half mile in length, laid on parallel streets about three blocks apart. Both were laid about the same time and each had a coefficient of approximately 40. The physical appearance (Fig. 1) of the corrosion in each was the same, and gave the same difficulty in cleaning. About 40 lb. of pressure was available to drive the cleaning machine, and this was not enough to drive the machine over about 1,000 ft. It was necessary in both cases to boost pressure with a fire engine to drive the machine through. From visual inspection, both lines appeared thoroughly clean, and about 4 to 5 cu.yd. of material was hauled away after cleaning each line.

The next pipe cleaned was No. 4, a 12-in. line running parallel to and between the two 12-in. lines above mentioned, and of about the same length. The coefficient of this pipe was 51. The physical appearance (Fig. 2) of the corrosion in this pipe was different from the other two; the tubercles were larger, further apart and much harder. The cleaning machine was driven through the pipe easily with 40 lb. of pressure, but visual inspection showed that the machine had failed to remove all of the corrosion. The cleaning machine was sent through the pipe a second time without trouble, removing about the same amount of corrosion as before. Inspection disclosed that only the top one-quarter or less of the pipe had been thoroughly cleaned, with some 60 per cent of the entire corrosion removed.

The last line cleaned was No. 5, a 10-in. line laid in 1915. This is the high-service pumping line and carries about 80 lb. pressure and has a velocity of 3.12 fps. for about 20 hours each day. The coefficient of this pipe was 45. The appearance of the corrosion in this pipe was different from the two previous types. The corrosion was harder and the tubercles were smaller but more numerous, probably due to the higher velocity of water passing through this line. The cleaning machine was driven through without great difficulty, negotiating seven 90-deg. bends. There was a slight delay when the machine stuck on a bad joint in the sixth bend, but a surge in the line was sufficient to free it. Inspection after cleaning showed the top half of the pipe thoroughly clean, but the bottom half varied—it was thoroughly clean at the spring line but none of the corrosion had been removed at the bottom of the pipe.

Results of Cleaning

By mutual consent of the city and the contractor, it was decided to complete the work on the mains not thoroughly cleaned, when the cleaning program was undertaken in 1946. The contractor plans to use a different type of scraper on the mains with the harder type corrosion.

Main cleaning is troublesome work, and much of Petersburg's was done at night. However, no great difficulties were encountered other than those previously mentioned. All pipe cuts were repaired with "Dresser" couplings. All services were cut off prior to cleaning and mains were flushed before resuming service. Only one service and two meters were stopped during the entire program.

Such severe corrosion of cast-iron pipe in such short periods of time was no doubt due to the chemical characteristics of the raw and finished water. Two years ago lime treatment was started as a means to combat this problem. The pH was gradually increased from an average of 6.4 to 8.0.

Last spring, before the main cleaning, an Enslow continuous stability indicator was purchased, and the pH value of the finished water is maintained at 8.6 to 9.3 to match the value shown by the indicator. The following table shows the pH, alkalinity and CO_2 values for the raw water and the finished water before and after the use of lime treatment.

	pH	Alkalinity ppm.	CO_2 ppm.
Raw	6.7-7.5	15-32	2- 6
Finished, before lime treatment	5.8-6.7	5-25	7-16
Finished, after lime treatment	8.6-9.3	22-36	0

There are not sufficient data available to report on the effectiveness of the lime treatment with the stability indicator at this time, except to say that about 90 per cent of the red water complaints, which were considerable prior to lime treatment, have been eliminated; and there was a reduction of about 75 per cent in stopped meters this summer. As a positive check on the value of the treatment it is planned to check the coefficient of pipes cleaned after one year's service. After a few more years of main cleaning and checking coefficients, more definite information on this subject may be available.

Acknowledgments

The author would like to acknowledge the helpfulness of the "Report on Water Distribution System, Petersburg, Virginia, 1945," prepared by E. Shaw Cole, Chief Engineer, The Pitometer Company, and the information and pictures furnished by J. A. Frank, Engineer, National Water Main Cleaning Company, who supervised the main cleaning.

Asher Atkinson Dies

Long Time New Brunswick, N. J., City Engineer

Asher Atkinson, consultant to the New Brunswick, N. J., Water Department, and City Engineer of that city for 42 years, died early in January.

Mr. Atkinson was born in New Brunswick, was graduated from Rutgers University in 1885. He became City Engineer in 1906 and served with but one interruption until his retirement in 1937. It was under his supervision that most of the sewer lines were installed and Farrington Lake was dammed as a source of water supply for the city.

Mr. Atkinson was one of the first members of the Raritan Terminal and Waterway Association, now known as the Port Raritan District Commission. He was a member of the American Water Works Association and the American Society of Civil Engineers.

ADVANTAGES OF CEMENT LININGS FOR CAST-IRON PIPE*

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THE two principal advantages of cement linings for water pipe are: (1) the increase in carrying capacity when the pipe is new and the maintenance of its original capacity as it gets older; (2) the mitigation of tastes, odors and red water difficulties. This paper is limited to a discussion of the first advantage, namely, the increased carrying capacity.

The Author

In order to understand the financial advantages of using cement linings it is necessary to have some knowledge of certain hydraulic phenomena that enter into the problem. It is a fact that when water moves through pipe a certain amount of friction is developed between the water and the inside of the pipe. The result is that, as the water travels along the pipe, some of the energy imparted to it by the pump is consumed by friction resulting in a loss of pressure. The amount of friction so developed is the criterion by which the size of pipe and the amount of power to be used for pumping purposes are determined. When a given amount of water is to be transported the total amount of friction developed depends on the size and length of the pipe and the condition of its interior.

The Hazen-Williams Formula

As early as 1775, Chezy, a French engineer, recognizing the fact that the rate of flow of water through pipelines with identical diameters and lengths was not a constant, proposed the use of a formula for determining pipe capacity. His formula was difficult to use because it contained a coefficient that varied with each set of circumstances surrounding the particular project under consideration. This formula has, to all practical intents and purposes, been superseded (since about 1905) by the Hazen-Williams formula:

$$V = Cr^{0.63} s^{0.54} 0.001^{-0.04}$$

This formula was developed empirically from results of tests on a number of water lines throughout the United States. The coefficient C in this formula is intended to reflect the condition of the interior of the pipe. The other values in the formula have to do with length, loss of head and size of pipe. In this paper we are concerned only with the value of C. According to Hazen and Williams the value of C for new hot-coal-tar-dip cast-iron pipe is 130. Tables published in connection with this formula indicate that this value falls off with time and varies with different sizes of pipe. For example, according to the Hazen-Williams tables, 12-in. pipe reaches a coefficient of 100 at the end of 17 years and a coefficient of 80 at the end of 37 years, whereas a 36-in. pipe reaches a coefficient of 100 in 20 years and a coefficient of 80 in 44 years. Since the coefficient is a direct measure of the amount of water delivered under a given set of conditions, this means that at the end of 37 years a 12-in. pipe would deliver about 60 per cent as much water as a new pipe. Engineers recognized that, while falling off in carrying capacity was a common experience in certain parts of the country, there were places where there was either no change, or only a very slight change in carrying capacity depending on the character of water conveyed. As a precautionary measure it became common practice for engineers to assume a Hazen-Williams coefficient of 100 for design purposes regardless of water characteristics. As a result of this, in those places where tuberculation did not occur, the consumer received better service, exemplified either by higher pressure or lower pumping costs. On the other hand, in those places where tuberculation did occur, the reverse was the case, and as time went on pressure either became less or power costs more.

Early Pipe Linings

European engineers attempted to develop linings to prevent tuberculation a great many years ago and about 80 years ago an effort was made in this country to produce a pipe that would not tuberculate. The result was the development of Phipps Patent pipe, which consisted of a thin steel shell with thick (½-in. plus) cement-mortar lining and coating. This type of pipe solved the problem of tuberculation, but was difficult to maintain because of its low beam strength and the high rate of joint leakage and because of the difficulty of making taps. Furthermore, when the outer shell cracked, corrosion very quickly took out the thin steel shell. In spite of the drawbacks of this kind of pipe, some of it is still in service after more than 70 years, and cement-lined service pipes developed in New England many years ago are still commonly used in that part of the country.

In 1921 the first effort was made to provide cement linings for cast-iron pipe. This was due originally to the efforts of Dr. J. E. Gibson of Charleston, S.C., and the management of the American Cast Iron Pipe Company. Cement-lined cast-iron pipe has now been in service long enough to demonstrate the fact that it has a continued high flow coefficient. Tests by the staff of the Cast Iron Pipe Research Association, as well as others, prove this point. Notable results were obtained at Charleston, S.C., where tests made over a number of years indicate practically no loss in capacity during a 23-year period, in spite of the fact that a highly tuberculating water is handled.

Tests have indicated that less friction results when cement linings are used, even where non-tuberculating waters are found. For instance, a test made at Lincoln, Neb., on a new 36-in. hot-coal-tar-dip supply line showed it had a coefficient of approximately 135. A test on a new 36-in. cement-lined pipe installed at Corpus Christi, Tex., gave a value of 145. Since in both cases new pipe was tested, the principal difference had to do with condition of the interior.

The Economics of Linings

In order to demonstrate the economics of linings let us consider a

*A paper presented before the North Carolina Section of the Amer. Water Works Assn. and published here by permission of the Association.

TABLE I

Assumptions

Water demand of new pipe: 3 mgd.
Water demand 30 years later: 4 mgd., then constant.
Length of line: 20,000 ft.
Delivery pressure: 100 ft.
Power cost for pumping 1 mgd. 1 ft. high: $.05.
Interest: 4%.
Coefficient of cement-lined pipe: 140.
Coefficient of tar-dipped pipe: In accordance with Hazen-Williams tables starting with 130.

Cost of pipe installed:

in.	ft.
16	$5.00
18	5.60
20 (tar-dipped)	6.00
24	7.50

20-in. Tar-Dipped

Period Covered Yr.	Demand mgd.	C	Loss per 1,000 Ft.	Total Head on Pump, Ft.	Mil. Ft. Gal.	Power Cost per Day	Interest and Sinking Fund per Day	Power Cost Plus Interest and Sinking Fund per Day	Pump Cost for 5-Yr. Period	Cumulative Pumping Cost
0-5	3.083	125	0.93	119	367	$18.40	$13.40	$31.80	$58,000	$58,000
5-10....	3.250	116	1.17	123	400	20.00	13.40	33.40	61,000	119,000
10-15....	3.410	108	1.47	129	440	22.00	13.40	35.40	64,600	183,600
15-20....	3.576	100	1.83	137	490	24.50	13.40	37.90	69,200	252,800
20-25....	3.742	94	2.25	145	543	27.15	13.40	40.55	74,100	326,900
25-30....	3.908	89	2.70	154	603	30.15	13.40	43.55	79,500	406,400
30-35....	4.000	85	3.05	161	644	32.20	13.40	45.60	83,200	489,600
35-40....	4.000	81	3.32	166	664	33.20	13.40	46.60	85,000	574,600
40-45....	4.000	77	3.65	173	692	34.60	13.40	48.00	87,600	662,200

18-in. Cement-Lined

0-5	3.083	140	1.25	125	385	19.25	12.50	31.75	57,900	57,900
5-10....	3.250	140	1.37	127	412	20.60	12.50	33.10	60,300	118,200
10-15....	3.410	140	1.50	130	444	22.20	12.50	34.70	63,300	181,500
15-20....	3.576	140	1.65	133	475	23.75	12.50	36.25	66,100	247,600
20-25....	3.742	140	1.80	136	510	25.50	12.50	38.00	69,300	316,900
25-30....	3.908	140	1.94	139	543	27.15	12.50	39.65	72,300	389,200
30-35....	4.000	140	2.02	140	560	28.00	12.50	40.50	73,800	463,000
35-40....	4.000	140	2.02	140	560	28.00	12.50	40.50	73,800	536,800
40-45....	4.000	140	2.02	140	560	28.00	12.50	40.50	73,800	610,600

16-in. Cement-Lined

0-5	3.083	140	2.22	144	445	22.25	11.20	33.45	61,200	....

24-in. Cement-Lined

0-5	3.083	140	0.31	106	327	16.35	16.80	33.15	60,400	....

case based on flow conditions that prevailed at Corpus Christi at the time flow tests were made and project them into the future. A 36-in. (nominal diameter) cement-lined pipe under test was carrying 8,290,000 gpd. in a line 74,400 ft. long. The Hazen-Williams coefficient determined by the tests was 145 and the loss of head was 16.8 ft. Also tested was a 20-in. tar-coated line that had been in service 29 years and it was found to have a coefficient of 102. (It is safe to assume that at the end of one more year this coefficient would have been 100.) Assuming for the moment that the demand did not increase and assuming a pumping cost of 5c per mil. gal. 1 ft. high, the annual cost of pumping against friction head only if tar-dipped pipe were used (actual inside diameter 36.8-in.) would have ranged from $3,140 per year when new ($C = 130$) to $5,160 per year when the pipe had reached an age of 30 years ($C = 100$). In the case of cement-lined pipe the pumping cost for the first year ($C = 140$) would have been $2,540 and would remain the same throughout the 30-year period. The actual saving for this period resulting from the use of a cement lining would therefore be $48,300. As a matter of fact, in designing the pipeline the engineers, of necessity, have taken into account the growth of the community and the increased demand for water. It is highly probable that 30 years hence this line will be required to deliver 16 mgd. When this point is reached the annual cost of pumping this amount of water through a tar-dipped line would be $33,400. The annual cost of pumping the same amount of water against the friction head in a cement-lined pipe would be $17,130. The average annual saving in pumping cost between the cement-lined pipe and the tar-dipped pipe for the 30-year period amounts to $8,435 per year. Capitalizing this at 4 per cent, we find it would be economical to invest $210,875 in order to avoid the extra pumping cost. The actual cost of the lining at the present market price would be approximately $40,000.

Other Benefits of Cement Linings

Another factor to be considered is that if tar-dipped pipe were used the head when the pipe was new would be 184 ft. and this would increase to 278 ft. at the end of 30 years when 16 mgd. were being pumped. On the other hand, with the same increase in pumping the head on the cement-lined pipe would increase from 180 to only 222 ft. This increased pressure means that if tar-dipped pipe were to be used pipe of a heavier class would be required. It also means that leakage in the line would be increased.

Under certain circumstances in designing a pipe-line the use of cement linings may make it possible to use a pipe of a smaller diameter than if tar-dipped pipe were used. To demonstrate this the author has made certain assumptions regarding capacities and growth, and has

TABLE II

Assumptions

Water demand of new pipe: 12 mgd.
Water demand 30 years later: 16 mgd.
Length of line: 20,000 ft.
Delivery pressure: 100 ft.
Power cost for pumping 1 mgd. 1 ft. high: $.05
Interest 4%
Cost of 30-in. cement-lined pipe: $9.80 per ft.
Cost of 36-in. tar-dipped pipe: $11.80 per ft.
Coefficient of cement-lined pipe: 140.
Coefficient of tar-dipped pipe: In accordance with Hazen-Williams tables starting with 130.

36-in. Tar-Dipped

Period Covered Yr.	Demand mgd.	C	Loss per 1,000 Ft.	Total Head on Pump, Ft.	Mil. Ft. Gal.	Power Cost per Day	Interest and Sinking Fund per Day	Power Cost Plus Interest and Sinking Fund per Day	Pump Cost for 5-Yr. Period	Cumulative Pumping Cost
0-5 ...	12.33	126	0.68	114	1,410	$70.50	$26.40	$96.90	$176,500	$176,500
5-10...	13.00	118	0.85	117	1,520	76.00	26.40	102.40	187,000	363,500
10-15...	13.67	109	1.06	121	1,650	82.50	26.40	108.90	198,500	562,000
15-20...	14.33	103	1.28	126	1,810	90.50	26.40	116.90	213,200	775,200
20-25...	15.00	97	1.57	131	1,960	98.00	26.40	124.40	227,000	1,002,200
25-30...	15.67	92	1.90	138	2,160	108.00	26.40	134.40	245,500	1,247,700
30-35...	16.00	88	2.14	143	2,290	113.50	26.40	139.90	255,000	1,502,700
35-40...	16.00	84	2.32	146	2,340	117.00	26.40	143.40	262,000	1,764,700
40-45...	16.00	81	2.48	150	2,400	120.00	26.40	146.40	268,000	2,032,700

30-in. Cement-Lined

0-5 ...	12.33	140	1.35	127	1,570	78.50	21.90	100.40	183,300	183,300
5-10...	13.00	140	1.48	130	1,690	84.50	21.90	106.40	194,000	377,300
10-15...	13.67	140	1.64	133	1,830	91.50	21.90	113.40	207,200	584,500
15-20...	14.33	140	1.78	136	1,950	97.50	21.90	119.40	218,000	802,500
20-25...	15.00	140	1.95	139	2,080	104.00	21.90	125.90	229,500	1,032,000
25-30...	15.67	140	2.10	142	2,220	110.00	21.90	131.90	240,600	1,272,600
30-35...	16.00	140	2.19	144	2,300	115.00	21.90	136.90	250,000	1,522,600
35-40...	16.00	140	2.19	144	2,300	115.00	21.90	136.90	250,000	1,772,600
40-45...	16.00	140	2.19	144	2,300	115.00	21.90	136.90	250,000	2,022,600

worked out the actual pumping cost for each five-year period from the time the pipe is installed until it has reached the age of 45 years. The computations are shown in Table I. From this table it is evident that for the conditions assumed, an 18-in. cement-lined pipe would result in lower cost for delivery of water than would a 20-in. tar-dipped pipe. In arriving at these costs only the power cost for pumping and interest and sinking fund on the investment have been taken into account. Other costs, such as the cost of pumps, motors, pumping station labor, etc., would be the same regardless of the size of the pipe. Table I also gives the costs for 16-in. and 24-in. cement-lined pipe operating under similar conditions. In both cases the annual cost is greater than that for the 18-in. cement-lined pipe, indicating that 18-in. is the economical size to use.

Table I has indicated the possibility of using a smaller size of pipe if cement linings are used—the economy being apparent from the time the pipe is first installed. In larger diameters the effect is not so apparent until an age of approximately 30 years is reached, as demonstrated in Table II.

So far we have presented figures dealing only with large sized pipe that would be used for supply lines or for main feeder lines within a city. The argument of additional carrying capacity applies as well to minor distributors and to the smaller mains in the gridiron system, since, regardless of the size of pipe, there is less friction loss in cement-lined pipe than tar-dipped pipe. While it is true that the minimum size of pipe in distribution systems is usually established by some rule of an insurance rate-making body, the additional pressure available when cement linings are used may easily be the measure of the difference between getting sufficient water to stop a fire at its inception and of being penalized by reduced carrying capacity to the point where what would normally be a small fire becomes a major conflagration. It is also a fact that where tuberculating waters are found the falling off in carrying capacity of smaller mains takes place at a faster rate than is the case with larger mains. This means that in a comparatively short time the capacity of tar-coated pipe is so reduced that replacement becomes necessary. The cost of cement lining, which insures carrying capacity for the life of the pipe, is much less than the cost of replacement, even though that replacement might be delayed for as much as 45 years. The long physical life of cast-iron pipe means nothing if its carrying capacity becomes impaired, and the logical way to prevent this impairment is by the use of cement linings.

Eliassen Back at N.Y.U.

Rolf Eliassen, Maj. Corps of Engrs. (AUS) is back at N.Y.U. after nearly four years' service. Eliassen's most recent assignment was as professor of sanitary engineering at the GI University at Biarritz, France, where he spent almost eight months. Prior to that, Maj. Eliassen was Chief of the Sanitation Section in the 9th Corps Area at Fort Douglas, Utah, and prior to that held the same position in the 1st Corps Area with headquarters in N. Y.

Maj. Eliassen, who returned to the states before Christmas, expects to be released from service in time to resume teaching at New York University in the Spring Semester.

S. L. Davies to Peru for the I.I.A.A.

Mr. Samuel L. Davies, formerly Chief of the Field Party in Panama as a Major in the Sanitary Corps, AUS, was released from the Army last November but will remain with the Office of Inter-American Affairs as a civilian. Mr. Davies has been assigned to Lima, Peru, as Chief Sanitary Engineer and Associate Chief of Party.

This news comes to us from the Newsletter of the Health and Sanitation Division of the Institute of Inter-American Affairs, of which Colonel H. B. Gotaas is President.

Progress Notes on Latin American Work

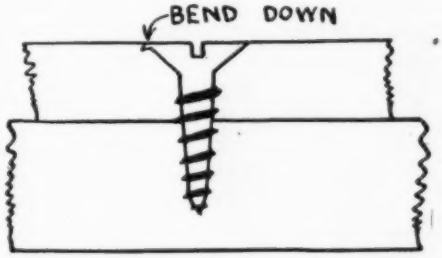
Among the recent progress of sanitation reported in the news letter of the Health and Sanitation Division of the Institute of Inter-American Affairs was the provision for the construction of sanitary sewers for the Naval Artillery School in Las Salinas near Vina del Mar in Chile.

Also reported is a new sewage system at San Jose de Maipo, which was completed early in September, 1945. This village, with a population of 1,300, is located on the Maipo River in the Province of Santiago, Chile. San Jose has a public water supply system but only recently developed this modern system of sanitary sewers. A total of $34,500 was expended in the construction.

In San Jose, Costa Rica, an agreement was signed last October providing for additional improvement of sanitary and storm water drainage. This new project will consist of building small stretches of sewers and surface drains. San Jose, Costa Rica, has an imperfect system of sewers and in the new sections of the city there was literally no provision for surface drainage. Sewage was discharged on the soil, which in turn drained off into any existing natural ditches. This sewage was washed off by abundant rainfall during the wet season, but in the dry season sewage ponds made excellent fly and mosquito breeding areas. To carry out this work, approximately 4,000 modified panama inverts were needed for the environs alone, and in addition a number of cement pipe sections.

How to Keep a Wood Screw from Coming Out*

It is not uncommon for screws in wood to gradually work loose and come out, particularly if the joined



pieces of wood are subject to constant strain and vibration.

There are a number of remedies or preventives, but the best one in the experience of this writer is to take a cold chisel and bend down an edge of the head as indicated in the accompanying rough sketch. The bent down portion will then serve as a brake or lock on the screw making it difficult to remove it even with a screwdriver. It can be removed only by breaking some of the retarding wood fibers.

Obviously, there is a point for making the bend at which the resistance to turning of the screw is greatest—where the bent portion must move "against" the grain of the wood and not "with" the grain. Give the matter a little serious thought and you will quickly comprehend the importance of this additional little point.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

JOINT WEST VA. WATER MEETING HAS LARGE ATTENDANCE

A Report by HARRY A. FABER*
Editorial Associate

Chairmen

D. V. Moses
Chemical Eng'r
Du Pont Co.
Charleston, W. Va.
(Incoming)

P. D. Simmons
Chemist
Weirton Steel Co.
Weirton, W. Va.
(Outgoing)

WEST VIRGINIA has a state section of the A. W. W. A. and a Conference on Water Purification. When these organizations met in Wheeling on November 15 and 16 the two groups were celebrating both their seventh joint meeting and the twentieth meeting of the Conference. The registration figure of 147 members and guests was the highest in five years.

A reception during the evening of November 14 provided an informal welcome for all attending the meeting, and a formal welcome was extended by Hon. Russell Goodwin, Mayor of Wheeling, who spoke at the first technical session. At the annual banquet of the joint meeting an address was presented by Dr. Paul N. Elbin, President, West Liberty State Teachers' College. Announcement was made at the banquet that Max K. Jones, Manager, Huntington Water Corporation, had been selected as recipient of the George W. Fuller Award. Mr. Jones was cited for his accomplishments in the improvement of relations between the water utility and its customers.

* Research Chemist, The Chlorine Institute, Inc., New York, N. Y.

New Officers Elected

Chairman

D. V. Moses
E. I. du Pont de Nemours Co.
Charleston

Vice Chairman

H. Cable Cramer, Manager
Catlettsburg, Kenova & Ceredo Water Co.
Kenova

Secretary-Treasurer

J. B. Harrington, Director
Division of Sanitary Engineering
State Health Dept.
Charleston

Awardee
Max Jones
Manager
Hunt'ton Water Co.
Huntington, W. Va.

Host
A. R. Todd
Supt. Filtr.
Water Dept.
Wheeling, W. Va.

Trustees

Three-year term—
Max K. Jones, Manager
Huntington Water Corp.
Huntington

Continuing in office—
D. H. Clark, Superintendent
West Virginia Water Service Co.
Welch

W. W. Hodge, Senior fellow
Mellon Institute
Pittsburgh, Pa.

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H. K. Gidley, Engineer,
Division of San. Engr., State Health Department,
Charleston.

Vice-Chmn.
H. Cabel Cramer
Manager
C. K. & C. Water Co.
Kenova, W. Va.

Sec'y-Treas.
J. B. Harrington
Chief Eng'r
W. Va. Dept. Hlth.
Charleston, W. Va.

Visit to Wheeling's Filtration Plant

Some of the problems of handling a heavily polluted raw water could be seen at first hand, when those attending the meeting took advantage of a planned visit to the Warwood Filtration Plant at Wheeling. As described in a paper presented by A. R. Todd, Superintendent, in a paper presented during the technical sessions, unusual features of the plant include presedimentation, breakpoint chlorination, aeration, dechlorination, and the use of Palmer filter washing units. In a program of filter reconstruction now under way, the rapid sand filters are being rebuilt using the Leopold system of perforated tile underdrains, and Anthrafilt instead of sand. A full scale section of underdrain construction was set up at the filter plant for inspection.

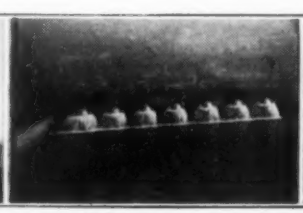
Simmons Presides at Technical Sessions

A sound motion picture, "Eternally Yours," showing the manufacture of wrought iron, was presented

Dr. Paul Elbin Speaking During Annual Dinner

Jam Packed Sessions Were Characteristic

Wheeling's Wash Water Tank



Aerators Wheeling Filter Plant

W. A. Buchanan, Chairman, State Water Comm., Speaking

by the A. M. Byers Co., Pittsburgh, Pa.

P. D. Simmons, Chemist, Weirton Steel Company, Weirton, was chairman of all technical sessions.

"A Demonstration of the Electronic Water Purification Process" —by F. E. Stuart, Pres., Stuart-Brumley Corp., Baltimore, Md.

Mr. Stuart briefly reviewed the theory and economics of employing aluminum in metallic form and in chemical compounds for the formation of aluminum floc. In the laboratory scale equipment used for demonstration, low voltage direct current (6 volts, 4 to 8 amps.) is connected to a small bank of aluminum plates. When the unit is immersed in a beaker of water for a period of 30 seconds and is agitated, aluminum is set free by electrolysis. The aluminum ions react with the alkalinity of the water to form a heavy floc which settles rapidly. In three samples of water provided for test of the device, equally satisfactory floc was formed in waters of quite different characteristics: Wheeling tap water, pH 7.6; Charleston raw water, pH 6.9; and Shinnston raw water, pH under 4.0.

This electronic process was described as producing the maximum floc in the minimum time and as accomplishing the maximum removal of color by coagulation. In discussion following the demonstration, L. H. Enslow, Editor, *Water & Sewage Works*, considered such treatment to be ideal for pressure filter installations where low volumes of water are handled. This is because the floc produced is formed quickly, it is a tough floc, and the compact installation possible is much superior to the notoriously inaccurate alum dosing pots generally provided. In reply to a question regarding the cost of treating water by the electronic process, Mr. Stuart quoted a general figure of $18 per mil. gal. determined in studies made at the University of Florida, and based on a one-cent per KWH charge for electric power.

"Some Problems of the Reconversion Period Affecting Water Works" —by Harry E. Jordan, Secretary, American Water Works Association, New York.

Panel of "Information Please" Experts

R. C. Bardwell, Supt. Water Supply, C. & O. Ry., Richmond, Va.
R. C. Clement, Div. Mgr., W. & T. Co., Newark, N. J.
H. E. Jordan, Exec. Sec'y, AWWA, New York, N. Y.
W. R. La Due, Mgr. & Engr., Dept. Water & Sewage, Akron, Ohio

(Fifth paneller—no room for picture—was L. H. Enslow, Editor, W. & S. W.)

Mr. Jordan summarized recent developments with respect to the availability of surplus war materials. A

National Directors of AWWA

T. L. Young, Manager, S'thside Water Co., Chester, W. Va. (Retiring)
H. K. Gidley, Assoc. Engr., W. Va. Dept. Hlth., Charleston, W. Va (Dir. Elect)

Division of Surplus Property Disposal has been created under the Federal Security Administration; the Office of Education and the Public Health Service are two agencies designated to act as liaison between Federal authorities, State authorities, and water works users, in regard to those materials of public health importance. He strongly advised all those interested in obtaining information concerning surplus property to have their names placed on mailing lists and described the proper procedure of doing this.

The importance of prompt action in on-the-ground inspection of items and in applications to purchase was stressed. It has been decided that publicly owned non-profit agencies will be allowed a discount of 40 per cent over listed prices. The interest of many members in this matter was evidenced by extended discussion which followed.

Programmers

Paul Blundon, Consulting Engineer, Keyser, W. Va.
Dr. W. W. Hodge, Dir. Eng. Sta. Univ. W. Va. Morgant'n, W. Va.
Dr. N. F. Gerrie, Dental Surgeon U. S. P. H. S. Richmond, Va.
J. B. Nickel, Chem. Engr. Tenn. Corp. Atlanta, Ga.
F. E. Stuart, President Stuart-Brumley Baltimore, Md.

The Human Problem of Public Relations

"Public Relations in Water Works Management"—by Max K. Jones, Manager, Huntington Water Corp., Huntington.

The public relations problem of a water works, according to the practical viewpoint expressed by Mr. Jones, should be defined as the contacts of the management with the public, the employees, and the owners. The public comprises the customers of the utility and, as customers, are entitled to many different types of information. It will be to the benefit of the water works to plan plant inspections and publicity to convince the public of the purity and availability of an adequate supply of water. Publicity can be of a wide range; newspaper feature stories of the chemist, engineer, and meter readers; news of new equipment and new developments; advertising on the institutional level; and radio features of local interest.

The employees of the utility are entitled to equal consideration with respect to rules and regulations, to promotions and insurance. The owners (who are either the taxpayers of a public utility or the investors in a private utility) should receive information, such as annual reports regarding the business aspects of the water works.

Mr. Jones explained that the results of a public relations program

Perkins Boynton Supt. of Purification Clarksburg, W. Va. and Mrs. Boynton

H. Cable Cramer, Mgr. C. K. & C. Water Co. Cattletsburg, Ky. Mrs. Cramer and Mary Frances

John Harrington Sec'y-Treas., and Comley Staff— Clara Carter (left) and Virginia Harris

Nuchar's "Art" Welch and his tin-can "Oscar" awarded that member making the most noise at the "Get-Together"

"Steve" Davis, Supt. Burwood-McMechen Water Wks., Mrs. "Steve" and Wendell La Due, Vice Pres. of AWWA

are not immediate, but that success requires study and repeated attacks. Wendell La Due, Vice-President of A. W. W. A., noted that this organization is actively entering the field of aiding in public relations. H. K. Gidley offered a motion that an annual award be established for the best yearly report of plant operation. His idea was voted approval and the chairman appointed a committee to report at the next meeting.

Panel of Experts for Question Period

More than one hour was spent, and spent most profitably, in a question period designed to provide the answers to questions submitted by members. Chairman Simmons asked the questions of the following "Board of Experts":

R. C. Bardwell, Supt. of Water Quality, C. and O. Railway Co., Richmond, Va.

R. C. Clement, Div. Mgr., Wallace and Tiernan Co., Newark, N. J.

L. H. Enslow, Editor, *Water & Sewage Works,* New York, N. Y.

W. R. La Due, Vice-Pres., A. W. W. A., and Supt., Bureau of Water and Sewerage, Akron, O.

H. E. Jordan, Secretary, A. W. W. A., New York, N. Y.

Some of the more interesting opinions were given on these problems:

Calgon and sodium hypochlorite solutions can be mixed and fed through a single feeder, but trouble may be experienced if calcium hypochlorite is employed. It is possible to feed a solution containing both alum and soda ash, but constant agitation is required and the practice is not recommended.

The quarterly reading of domestic water meters should be a satisfactory procedure but monthly reading of industrial meters was considered preferable. Valves and hydrants should be inspected regularly for safety and for grading by fire underwriters.

Sodium chlorite and chlorine, to provide chlorine dioxide, has been found to be effective for control of purely chemical tastes and odors, but its success with those due to vegetable decomposition is more limited. The ortho-tolidine test for residual chlorine was first suggested in 1909 and was developed in 1913, but was not simplified to the point where it became a simple and practical test for the small water plant until 1918.

There is no evidence that the virus causing poliomyelitis has ever been transmitted by a public water supply, but an epidemic of infectious hepatitis (a virus disease) has demonstrated that such diseases can be spread by infected water. Apparently when the extent of virus pollution is heavy and the water pollution is very recent the potential danger is greatest.

Water works officials should be given the legal right to refuse connections of private plumbing systems to the public supply through a suitable code or ordinance. The revised U. S. P. H. S. standards of water quality will soon be approved by an A. W. W. A. committee as national standards.

In a water system which is fully metered, the percentage of unaccounted for water will depend upon the age of the distribution system, the type of pipes and joints, the condition of meters, the method of determining water delivered from the pumping station, and the amount of water not measured—for fire fighting, street flushing, and free water. If 85 per cent of water can be accounted for, the system is meeting a better than average standard.

State Establishes Water Committee

"The West Virginia State Water Commission"—by W. A. Buchanan, Chairman, West Va. State Water Comm., and Director, Huntington Chamber of Commerce, Huntington, West. Va.

In recognizing that water is a natural resource in the industrial development of a state, and that the pollution of water supplies retards progress, a State Water Commission has been organized to plan the elimination of stream pollution. Mr. Buchanan described the aims and proposed activities of the group, the technical functions, and its policy of cooperating with other organizations and industries in order to accomplish its ends.

"Water Treatment with Ferric Sulfate"—by J. B. Nickel, Tennessee Corporation, Atlanta, Georgia.

Mr. Nickel evaluated the advantages and disadvantages of iron coagulants in a most helpful manner. The ferric sulfate coagulants were considered too costly until the last decade; they are now reasonably priced but require special handling. An ideal dissolving ratio is 1 part of

E. E. Chandler, Chemist, Consol. Coal Co., Fairmont, W. Va.; Earl Johnson, Dist. Mgr., W. & T. Co., Pittsburgh, Pa.; W. D. Coger, Supt., W. Va. Water Service Co., Weston, W. Va.

Dan Erion, Engr., and "Dad" Ray Erion, Supt. and Chemist, Milford Water Wks., Milford, Ohio (Both members, AWWA)

Host Todd, explaining Super and De-chlorination scheme and new Leopold Filter Bottoms at Wheeling Filter Plant

Ben Hubley, Dist. Mgr. Hersey Meter Co. Philadelphia, Pa., and A. E. Hargett, Dist. Mgr. Ford Meter Box Co. Wabash, Ind.

"Al" Scheinert, Dist. Mgr. Rensselaer Valve Co. Pittsburgh, Pa.

A. R. Todd, Wheeling Hayes Kuhns, Dist. Mgr. The Leadite Co. Killbuck, Ohio

V. S. Stockwell Supt. Light & Water Co. Richwood, W. Va.

N. S. Chamberlain Chemist W. & T. Co. Newark, N. J.

Edw. Shroyer Supt. Filtr. Water Dept. Fairmont, W. Va.

A. L. Rhodes Supt. W. Va. Water Ser. Bluefield, W. Va.

J. C. Edwards Supt. Filtr. H't'gton Wat. Co. H'tington, W. Va.

J. W. Chapman Supt. Water & Sewers Hurricane, W. Va.

M. G. Smith Manager Water Works Thomas, W. Va.

ferric sulfate to 3 parts of water, and a rotameter is the ideal equipment for measuring water flow in this application. Resistant material must be used for the dissolving unit which should provide 30 minutes of violent mechanical agitation. In order to obtain proper dispersion, this concentrated solution should be further diluted so that a solution of approximately 2.0 per cent ferric sulfate is delivered to the mixing chamber. A relatively long period of flocculation is required, despite the fact that iron floc forms rapidly.

If the raw water contains iron, then an iron coagulant will generally be more successful than alum. While efficient color removal — employing iron coagulants—is likely to result at pH values below 6.0 or above 8.0, the results at pH values between 6.3 and 7.8 will not be equally satisfactory. The use of break-point chlorination ahead of coagulation has been found to materially improve coagulation with iron salts and, in some instances, to show cost savings over ordinary coagulation. Removal of tastes and odors in coagulation is improved if the pH value of the raw water is not materially altered before filtration. The manufacturers of ferric sulfate will gladly supply technical assistance to new users of this coagulant.

"Experiences with Water Supply and Sanitation in the South Pacific" —by J. Paul Blundon, Consulting Engineer, Keyser, West Va.

Mr. Blundon described problems of water supply and sanitation on Pacific islands, explaining the situations under which sea-water distillation units, portable pressure filter and chlorinating equipment, or slow sand filters were found most suitable. He reported that Japanese equipment included chlorine or ozone tablets for canteen disinfection, and hand-operated units employing unglazed porcelain filters.

"The Chemical Engineer's Approach to the Industrial Waste Problem"—by John E. Tarman, Director, Consulting Division, W. H. and L. D. Betz, Philadelphia, Pa.

In reviewing this complicated problem of industry, Mr. Tarman presented a classification of wastes and summarized methods of reducing the volume discharged. He described the advantages of pretreatment and the processes employed for various degrees of separate treatment. The consulting engineer not only studies processes and problems, but represents his client in determining the suitability of waste treatment in conjunction with state health departments and other authorities involved.

"Putting a Small Filter Plant Back on Its Feet"—by R. B. Parsons, Supt., Municipal Water Works, Ripley, West Va.

The paper prepared by Mr. Parsons proved that an enterprising superintendent, willing to work hard at his ideas, could increase water sales from 30 to 55 thousand gallons per day and make the water system financially profitable. The efficiency of pumps and filters was restored, leaks were eliminated, and power requirements were reduced by 50 per cent.

"Experimental Use of Fluorine in Public Water Supplies"—by Dr. Norman F. Gerrie, Dental Surgeon (R), USPHS, Richmond, Va.

Dr. Gerrie reviewed the fact-finding studies which have indicated that the presence of about 0.1 ppm. fluorine in a public water supply may reduce tooth decay in children by some 50 per cent, and which have led to the plant scale applications of fluorine at Grand Rapids, Mich., Newburg, N. Y., and Brantford, Canada, to test this hypothesis.

"Automatic Operation Features of a Small Filtration Plant"—by E. H. Greenwald, Chief Engineer, and H. E. Davis, Electrical Engineer, Boone County Coal Corp., Sharples, West Va.

In the small supply described, original equipment was devised to provide 42,000 gpd. of filtered and chlorinated well water. Chemical feeders are controlled by solenoid valves, starting and stopping with pumps. Chlorine is fed to the raw water when the plant is not operating and the feed is shifted to post treatment when the plant is started. The plant goes into operation automatically when consumption lowers the water level in the clear well.

"Flow Analysis in Distribution System,"—by H. R. Speiden, Head, Dept. of Civil Engineering, West Va. Univ., Morgantown.

Professor Speiden employed slides showing a theoretical water system to illustrate the application of the Hazen-Williams formula, the equivalent flow method, and the Hardy Cross method, to the analysis of water flow.

"Proposed Federal Pollution Legislation"—by Dr. W. W. Hodge, Director, Engineering Expt. Sta., West Va. Univ., Morgantown.

Dr. Hodge reviewed the five bills

Dennis Clark Supt. of Water Welch, W. Va.

"Nick" Leshkow Supt. W. Va. Water Service Co. Princeton, W. Va.

Charlie Tappe Operator Wheeling Filter Plant

W. A. Welch "Nuchar" Sales Engr. W. Va. Pulp & Paper Co. Philadelphia, Pa

H. W. Keebler Sales Engr. and *Fred O. Leopold* President Leopold Filter Co. Pittsburgh, Pa.

introduced in each of the two houses of the 79th Congress and the Federal legislation proposed by each to provide pollution control agencies. In discussion, H. E. Jordan explained that the A. W. W. A. and Federation of Sewage Works Associations favored the Spence-Barkley bills except for certain provisions regarding grants for industrial waste treatment plants.

"Water Quality in the Ohio River at Wheeling"—by A. R. Todd, Supt. of Filtration, Wheeling, West. Va.

Mr. Todd cited ample evidence to support his contention that the Ohio River is so grossly polluted as to be no longer fit for a raw water supply. In the past twenty-five years the chlorine demand of the water has increased ten-fold. The treatment plant employs break-point chlorination and this treatment requires doses as high as 185 pounds of chlorine per mil. gal. in summer and 250 pounds per mil. gal. in winter. Through elaborate study the successful purification process now includes: aeration, coagulation of the raw water at pH 4.2, dechlorination, and adjustment of pH to 7.5. Chemical costs are $5.75 to $6.50 per mil. gal. The city has drilled four test wells and contemplates using a mixture of well water and river water in the future.

Effects of Copper and Lead Bearing Wastes on the Purification of Sewage

Purification of sewage water by microorganisms present in it can be retarded or stopped altogether if heavy metal ions, which possess bactericidal properties, are present. Professor M. M. Kalabina and her collaborators recently published an investigation of this problem. (See Hygiena i Sanitariya, vol. 9, No. 10-11, 1944).

Waste waters of copper and lead refineries contain high concentrations of toxic ions. Two samples investigated had (1) 3.8 mg./l. of CN, 7.8 mg./l. of Cu, 5.5 mg./l. of Pb, and 56 mg./l. of Zn, and (2) 3 mg./l. of Cu, 10.3 mg./l. of Pb, and 75 mg./l. of Zn. Although these waters are considerably diluted by other sewage containing practically no heavy ions, the final concentration still may be so high that the life processes in the reservoir will be adversely affected.

For examination of the effects of minute concentrations of metal ions on the metabolism of water reservoirs, the following procedure is adopted. Sewage water of a residential district (no heavy ions!) is diluted with tap water until its oxygen consumption is reduced to 12-15 mg. of oxygen per liter. To this liquid a few drops of a copper sulfate or a lead acetate solution are added. The number of bacteria per cubic centimer of the liquid is then determined after definite time intervals, and at the same time the oxydability of the liquid and the concentrations of ammonia, nitrites, nitrates, and hydrogen ions in it are measured.

The results of the bacteria counts are shown in Table I.

It is seen that the time of the maximum bacteria population is raised by 1 mg. of copper per liter from 1 day to 2 days, and by 5 mg. of copper to 4 days; the retardation of the self-purification is very considerable. The toxicity of lead is moderate, and noticeable only for a short time at lead concentrations above 1 mg. per liter. The growth of protozoa is, however, retarded by copper and lead at concentrations above 0.5 mg./l.

The rate of ammonia formation is not affected by lead and is retarded by copper only when its concentration is above 0.5 mg./l.

The rate of formation of nitrites and nitrates is shown in Table II.

TABLE II

Concentrations of nitrites and nitrates in mg. of N per liter.

Concn. (mg./l.)	Nitrites	Nitrates	
Copper	12*	16*	20*
0.0	12.5	...	8.0
0.1	7.0	...	8.0
0.5	8.0	...	8.0
5.0	0.15	...	0.7
50.0	0.07	...	0.2
Lead			
0.0	1.0	10.0	..
0.05	0.7	10.0	..
0.5	0.35	6.0	..
5.0	0.15	3.0	..
10.0	0.07	1.5	..

*Days.

It is seen that concentrations above 0.5 mg./l. retard nitrification noticeably.

The biochemical oxidation of organic matter is retarded by as little as 0.1 mg./l. of lead.

Kalabina's conclusion is that waste water of metallurgical plants must be diluted so far that the resulting liquid contains not more than 0.1 mg./l. either of copper or of lead.

TABLE I.

Number of bacteria (in thousands) in 1 c. c. of water

Concn. (mg./l.)	Hours					Days		
Copper	0	1	4	7	21	30	2	4	6
0.0	575	570	465	705	38,250	39,800	1,900	80	93
0.1	360	382	443	990	10,250	14,000	1,580	70	34
0.5	402	...	...	...	3,900	.....	9,200	1,148	1,516
1.0	425	96	42	39	2,230	11,375	18,800	3,130	2,033
5.0	482	...	...	...	38	.....	23,885	30,075	19,200
10.0	211	13	2	0.3	2	1	1	310	3,400
50.0	119	25	2	0.3	0.2	0.1	0.03	0.01	0.01
Lead									
0.0	255	294	480	1,400	6,900	7,650	15,500	3,285	.....
0.1	187	473	740	1,830	8,200	13,710	8,400	2,900	.....
0.5	186	...	...	...	9,715	.....	17,520	7,275	.....
1.0	215	239	345	701	9,006	9,750	14,000	5,835	.....
5.0	290	...	...	...	4,473	.....	17,170	1,709	.....
10.0	258	212	227	312	3,255	10,395	12,700	3,163	.....
50.0	231	...	...	...	332	.....	18,750	3,960	.....

Pittsburgh Corrosion Forum Discusses Atmospheric Corrosion

The Corrosion Forum organized in Pittsburgh in October held a meeting recently with 70 in attendance to hear C. J. Couy, Div. Engineer of the Duquesne Light Co., speak on corrosion of overhead lines in industrial atmospheres.

Among the many points raised in the discussion were protective coatings, effect of prevailing winds, temperature, weather, and atmospheric pollution. At the next meeting, January 14th, D. B. Williamson, of the Peoples Natural Gas Co., will talk on corrosion of pipe lines. Temporary secretary is Richard Rimbach, 1131 Wolfindale Street, Pittsburgh 12, Pa.

Removing DDT From Water Supplies

According to the January issue of the *Bulletin of the U. S. Medical Department*, experiments on the ability of water purification methods to remove DDT from a water supply have been made. The work was done under the direction of Capt. John A. Carollo, Sn. C. in the 4th Service Command Laboratory in cooperation with the City of Atlanta. The xanthydrol-Koh-pyridine method of determination was used. This method is sensitive to 0.05 ppm.

The experimental work showed that either alum or iron salts coagulation followed by activated carbon, and filtration was effective. Iron salts are slightly more effective and activated carbon should be added after the floc is removed in order to be most effective. Two ppm. of activated carbon with 30 minutes' contact is sufficient to remove all but high contents of DDT.

Small residual portions of DDT remaining after coagulation and filtration can be removed by 4 to 5 days' storage or by filtration through cation and anion zeolites.

FINE SCREEN FILTERS FOR SEWAGE TREATMENT

By G. MACLEAN GARDNER*
Mechanical Engineer
ANN ARBOR, MICH.

WITH the cessation of hostilities on the world wide fronts and a return to the pursuits of peace and happiness, it goes without saying that this peace and happiness is very definitely bound up with the health of the peoples in every land.

The Author

Health is paramount, but even in this fair land of ours we know that much has to be done in sanitation before we can claim to have done all we can for the basic health of our communities.

Before the war, the general economics of any project loomed large in the minds of the city fathers and their councils and rightly so, for it is only good business to see to it that any community gets the most and the best for every dollar spent. In the interim, however, the general public has become sharply aware of how quickly money can be found, by the billions, for destruction, and will expect that a reasonable amount, at least, of the general expenditure be channelled to the treatment of sewage and the cleaning up of the streams and waterways throughout the country.

There is no doubt that much will be accomplished in this field for, first, much has to be done and, secondly, it is obvious that the man power that may be absorbed from the fast growing availability in the labor market to do the necessary work, can be quite considerable and far reaching in its effect on the prosperity as well as the health of the nation.

Each community will be guided in its decisions on the manner and nature of its sewage treatment and disposal by its own capable engineering heads and by the experiences of other cities and towns in the past; and it should be found by many, particularly those situated on large bodies of water, that the degree of treatment and removal required may be adequately served by a fine screening plant.

*Registered Professional Engineer, Member ASME.

Concerning Fine Screens

It will be disclosed, too, that conceptions of fine screening in the past are not a criterion of what may be installed today for much has been done in the way of new designs of screen structures, new screen plates, positive seal rings, and completely automatic control of screening and brushing operations, where the screen may be run at infinitely variable speeds while the brush driving components will either operate constantly or stop and then automatically begin brushing operations at a predetermined number of rotations of the screen, depending on the nature of the sewage at that particular time. This allows a filter mat of the sewage solids to collect on the screens and aid in the removals.

When operating, the brushes are in contact with the swept surface of the screen only and automatically raise off trough or trail area of screen, thus greatly cutting down the wear of brushes and lessening replacements.

The latest type of screen plate is highly efficient and when damaged in operation it may be repaired like new in even the smallest area without removal of the plate itself. With some small pieces of the screen components kept on hand as spares, a screen repair can be made in an hour, thus obviating the long shutdowns necessary in older types. This plate is also much lower in first cost.

The life of the whole screen structure is also much lengthened by the advent of new materials or by completely metallizing the structure with non-corrosive metallic coatings to suit any particular type of sewage which might be prevalent in a community. With modern, efficient design the structural weight is materially reduced, thus lowering the unit loading on bearings and adding to the life of the general assembly as well as reducing the maintenance cost during that life.

Clearing Up Misconceptions

A discussion of some of the former misconceptions of screen design and operation may be helpful at this time and may be a guide to those responsible for the operation of screening plants in the selection of any replacements which may now be necessary after the procurement difficulties of the war years with the overwrought condition of their present equipment.

Take, for instance, the costly fallacy of having the slots in sewage screens follow exactly, or even remotely, the track of the cleaning brushes with the idea of brushing out the trapped solids between the slots. Let's see what happens! The brushes are let down low enough so that the bristles can go through the slot in the screen in order to clean these spaces; but since the bristles are not themselves educated to the point of curling up nicely at their extremities in order to trap the solids and lift them upwards to the surface of the screen, they simply drive the clogged matter through the screen and down into the effluent from which already an attempt has been made to separate them.

The idea is basically wrong and the cost of making a screen plate with strips following the brushing track or even a two-direction slot is increased about 30 per cent.

Brushing a screen with the bristles down to the screen surface only and even across the slots will do a very much better job, and a screen plate with slots parallel to the trailing radial line and the full length of the plate is a much more sensible job, economically.

It has been said that fine screening, as such, does little but remove the unsightly solids from a sewage and that practically no suspended solids are separated. This may have been almost correct in the past inasmuch as the mechanical designs were not refined to the point where the very best results could be obtained.

This writer had the opportunity, a few years ago, to study existing equipment for fine screening purposes and it seemed that about 25 per cent of the raw sewage was go-

ing through at the seal rings in the lower, high head, sections of the periphery. This would not be the case in the early days of the equipment, when the periphery of the screen and the wearing edge of the outer, adjustable seal plate were not further apart than the dimension of the slot in the screen—say 1/32 of an inch.

However, with certain types of gritty sewage this 1/32 in. space does not long remain at that figure, and those who think that this trouble is remedied by just moving in the outside, adjustable seal plate to close the worn distance, evidently haven't given it much thought. The fact is that the periphery of the screen being ground down to a smaller radius and the edge of the movable, curved plate to a larger radius precludes the possibility of ever bringing those two edges back to a position parallel to each other. The outer, so-called adjustable seal plate would have to be removed and new ones with a radius of 1/32 in. greater than the continually ground-down periphery of the screen procured to replace the original—or a removable screen periphery strip to a continually increasing radius to close the worn edges would have to be supplied.

The answer is that that type of sealing, like the curved slots in the screen plate, is basically wrong and precludes the possibility of doing a really serious job of removing suspended solids by fine screening.

There has also been adverse criticism of the attempts made to filter sewage through a mat of fine coal or "Anthrafilt" but let it be said that no screening equipment has properly been designed to handle this operation and that now, with deductions made from tests and operations made on unsuitable equipment, some very different results may be obtained on new screening equipment designed specifically for handling filter media on the surface.

Past Performance No Criteria

As has been said, fine screening operations of the past are no criterion of what can be done today in the way of clean, modern design as well as in the results obtained, and even if one were to take what is generally held to be the newest of our screening plants, that of the City of Niagara Falls, N. Y., as an example, it would suffer greatly in comparison with one of present day design, although it is only six or seven years old.

It should be said, however, that the Niagara Falls plant has been in excellent operation in those years. The city is deserving of the highest commendation in the advances which it has made in one of the most difficult problems in the whole country, and for the way it has solved these, and the refinements which have resulted from its experiences.

It may also be comforting to many communities using fine screening plants of some age to know that they can be modernized and brought up to date with resultant higher efficiences and lower operating costs.

Hereunder are described several types of screens and their manufacture:

West Wing—Niagara Falls, N. Y., Sewage Treatment Works
(Three Fine Screens in each wing—Operating Floor above screens—Air Ejector Pots beneath screens for transporting screenings to storage and ultimate incineration)

Types of Screens

1. *Swaged wire or ribbon type:* These are formed of strips rolled or swaged from wire of diameter requisite to the desired thickness and width and may, of course, be obtained in any of the non-corrosive materials such as stainless steel, several bronze alloys, and strong aluminum alloys.

Strips or ribbons of other cross sectional shapes than that resulting from rolling or swaging wire may be obtained but require the same procedure in forming a filter screen.

2. *Milled and slotted sheet or plate type:* These are formed of sheet of the thickness desired for the depth of screen section and are milled or gashed from the under side for part of the thickness of sheet, as a relief, and then slotted through to the top surface with fine saws to give the requisite screen slot.

3. *Wire cloth and perforated thin sheet:* These may be formed by stretching wire cloth or perforated thin sheet of non-corrosive material on a framework of sufficient strength and small enough panel size to enable the resultant screen to be walked on or knelt on in cleaning and maintenance.

4. *Rolled or drawn M.&T. strip type:* These are formed of strips approximately one and one-eighth inches wide which have been rolled or drawn at the mill to the desired screen section leaving only the fine slot to be punched or slotted through to the top surface. These M.&T. strips are then electro-pressure welded or rivetted to the frame structure. They can be supplied in any of the non-corrosive materials.

DESCRIPTION OF SCREEN AND ITS MANUFACTURE

Swaged Wire Type

Screen number (1) of swaged wire or ribbon type is built up from strips which are swaged from wire of the desired material; the swaging flattens the wire out, with highly repetitive blows, to the requisite thickness and the original diameter of the wire can determine the width of the strip.

This swaging operation greatly increases the ultimate strength of the metal strip (as much as 60 per cent) but with a correspondingly lower percentage of elongation. This strip, however, has the disadvantage of having a slightly rounded top edge, due to the original radius of the wire, and when set up in the frame to form a screen, presents a trap for solids.

View Looking Down on Fine Screen—Niagara Falls, N. Y.
(Rotating brush sweep screenings from screen into air ejector pot, below, rear. Brush driving mechanism on grating operating floor.)

There is the further disadvantage of serious difficulty in attaching the strips to the frame work, particularly in the stainless steel material.

In the past the method of attaching these stainless steel strips has been by brazing, welding, hard or silver soldering and, in some cases, owing to difficulty they ended by being soft soldered which, even to the uninitiated, would be hardly acceptable in a sewage screen.

Whatever method is adopted attaching these strips or ribbons to the framework will prove to be a highly expensive business—in fact, prohibitive. In addition, if they are torch welded on the top edges a serious problem is presented in the selection of the proper welding rod and in the excess material which may have to be ground off the surface. This, together with the cone flame temperature of the torch, is likely to have destroyed the non-corrosive surface of the metal at that point.

Further, in torch or acetylene welding of 18-8 or 20-10 stainless steel, the parts should be preheated to 300°—400° F. and this, together with the torch heat, causes serious distortion of the structure, and the resultant cold straightening is liable to crack the small welding blobs between the strips.

One way of welding these strips on the top surface and insuring the preservation of the non-corrosive qualities of the metal would be by the use of a new type torch which would provide a helium gas shroud around the oxy-acetylene hot gas doing the welding, thus excluding the oxygen from the surrounding atmosphere.

This, of course, would not solve the problem of excessive cost of this type screen nor would the only correct method of attaching these strips to the frame work (that of electro pressure welding the strips at their lower edges in the slots of the cross members) provide an economic solution, although it would be cheaper and much better than the torch tack welding between the strips on the top surface.

A strip screen assembled by torch welding should be subjected to a pickling process and cleaned for descaling, followed by a passivating procedure to further insure the re-

turn to non-corrosive protection of the surfaces subjected to torch heat and some resultant grinding.

Milled and Slotted Plate Type

Screen number (2) is formed by using a sheet of the desired material of thickness equal to the required depth of the screen and milling or gashing the under surface for part of the thickness, then slotting the fine orifices through to the surface with gang-slotting saws.

In a fine screen where the ultimate in open area is desired, this, too, proves to be a very costly job and not very satisfactory. There are heating and warping problems in gang sawing the slots which cause some of the strips to vary in thickness; the thin ones move laterally in operation and present a larger slot than is desired in the finished fine screen.

There is also the problem of attaching the slotted plate to the supporting frame work, usually solved by rivetting. Making a repair of this plate requires its complete removal and is a costly operation.

The resultant screen is highly expensive due to the 60 per cent waste of the costly sheet in the milling and slotting in the first place and the expense of performing this milling and slotting on large, unwieldy sheets.

The material used, so far, in screens of this type has been bronze sheet but one wonders who would tackle the job if the specifications called for stainless steel.

Wire Cloth and Perforated Sheet Type

Screen number (3) has so many disadvantages for use as a fine screen in sewage treatment as well as difficulties in its manufacture that we need not take time to enumerate its advantages, if any.

M&T Rolled or Drawn Strip Type

Screen number (4) is known as the M&T strip type and is formed by the use of strips approximately one and one-eighth inches wide, which have been rolled, drawn or extruded at the mill to a cross section which requires only the finish fine slot through one-eighth inch material. This reduces the wasted expensive material of screen number (2) of 60 per cent to a loss, in this case, of only 7 per cent.

In addition, there is the ease of slotting in strips less than two inches wide and in attaching these strips to the supporting frame by electro-pressure welding or by rivetting, both means being achieved easily and cheaply.

One M&T strip is equal to nineteen (19) of the single strips and can be securely fastened at each cross member in twenty seconds by the electro-pressure welding method in stainless steel and slightly greater time in the less homogeneous alloys. In the rivetted method it takes a total time of two minutes for the operations required at each cross member of the frame. The rivets are deep countersunk on the top surface of the strip and are set up with a liberal buck tail on the underside of cross members, thus making it easy to remove a damaged piece, however small, and replace quickly.

Another advantage of the M&T type construction is the fact that with a few M&T strips on hand at the plant a repair can be made in a very short time and without taking the screen section off the structure. This prevents any lengthy tie-up of operations.

Altogether, this type screen seems to represent a distinct advance over all other existing patterns, and added to its many advantages including ease of manufacture is the most important one, comparatively low cost of installation as well as maintenance.

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102 Penna. Industries Notified to Develop Plans for Waste Treatment Before June 1st

The Pennsylvania Sanitary Water Board and the State Dept. of Health sound as if they really mean business in their current program of securing stream pollution abatement in Pennsylvania.

After having notified 300 or more municipalities during 1945 to prepare plans for sewage treatment, more recently better than 100 Pennsylvania industries (102 as of Nov. 1, '45) have been notified to abate pollution of streams at once, or else to prepare plans for waste treatment plants and/or waste utilization before June 1, 1946. In citing the 102 polluters in a published list, the Sanitary Water Board requested that progress reports be made Feb. 1 and April 1.

In the Pennsylvania planning law for municipal treatment plants the state bears 50 per cent of the cost of developing plans and specifications. In turn, the State insists on the procurement of qualified engineering services by such municipalities by stipulating in the State aid agreement that engineers engaged for such work must be paid fees not less than the schedule of fees and salaries for engineers recently recommended by the Pennsylvania Society of Professional Engineers.

[This precedent set by Pennsylvania seems worthy of consideration and widespread adoption in principle by other state and governmental bodies having a hand in public works planning and construction. This, regardless of whether state or federal aid is involved, for the requirement is in the final analysis a protection to the taxpayers of the state.—L. H. E.]

U. S. Public Health Service Seeking Sanitary Engineers

Sanitary engineers who can qualify will be interested in the recent announcement by the U. S. Public Health Service of examinations to be held in 10 of the larger cities during April and May.

These examinations are being held to establish an eligible list for the appointment of Senior Sanitary Engineers and Assistant Engineers in the Regular (Commissioned) Corps of the U. S. Public Health Service. In consequence, a physical examination must be passed as well as the professional tests.

Applicants must be 21 years old but no upper age limit is set. Assistant Engineers must have received a degree in engineering (major course sanitary engineering) and a total of 7 years of college and professional experience. The starting salary is $3,411 for those with dependents or $2,975.50 for those without. Senior Assistant Engineers must be able to show 11 years of educational and professional experience. The salary begins at $3,991 for those with dependents or $3,555.50 for those without.

For the detailed announcement specifying qualifications and giving locations and dates of examinations and for application forms, apply to Sanitary Engineering Div., U. S. P. H. S., Washington, D. C.

HIGH CAPACITY TRICKLING FILTERS

Part I–Single Stage Filter Operation and Results

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THE material in this article is presented for the purpose of setting forth the merits of high-capacity trickling filters and their proper place in the field of sewage treatment. In the preparation of this material, the results produced by a number of trickling filter installations were studied.

The Author

It is fundamental that sewage plants be designed around the type of treatment proposed. Kessler[1] has called attention to this urgency. Some persons believe that low BOD. loadings to the filter are necessary if good results are to be obtained, but data tabulated herein show that very satisfactory effluents can be produced with loadings ranging from 1.25 to 2.0 lb. per cu. yd. of media, settled sewage basis, exclusive of recirculated BOD.

The fact that the same flora and fauna are common to both high and low-capacity filters and that in no few instances high-capacity filters have produced efficiencies from six to seven times that of the conventional filter, challenges the sanitary engineering profession with the job of constructing efficient filter installations. This will in turn mean thousands of dollars in saving to the public.

This study and interpretation of single and two stage high capacity trickling filter operation, and the causes for poor results, is necessarily of considerable length. In order to simplify its presentation, this article has been divided into three parts. To further simplify the presentation, the cuts, conclusions, and references are numbered consecutively in the three parts. The subtitles of the three parts are: Part I—Single Stage Filter Operation and Results; Part II—Causes of Poor Performance in Filter Operation; Part III—Two Stage Filters.

How High-Capacity Filters Do Their Work

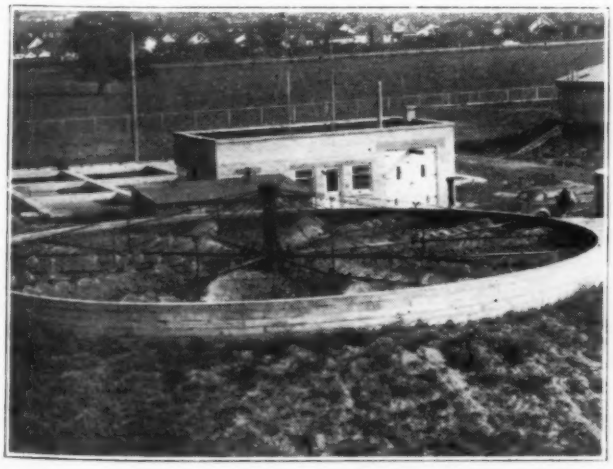
A high-capacity filter does the extra amount of work in one of two ways: either by heavy parallel recirculation or by applying the sewage uniformly to the filter surface in a rain-drop form with a minimum of recirculation. If the work is to be done by a low-momentary-rate of application and with a minimum amount of recirculation, a distributor must be provided which breaks the sewage into rain-drop form. Such a distributor is that of the "Aero-filter." If the kind of distributor suitable for a high-momentary rate is used with an Aero-filter plant design, the result will be inferior. Results from the various installations given herein reveal that in every case where a high-momentary rate (film type application) has been employed a relatively heavy amount of parallel recirculation has been necessary to provide filter efficiencies on a par with rain-drop application without parallel recirculation.

In order to understand the full meaning of this article it is necessary to know what is meant by the terms *rates* and *capacities* as well as by parallel and non-parallel recirculation.

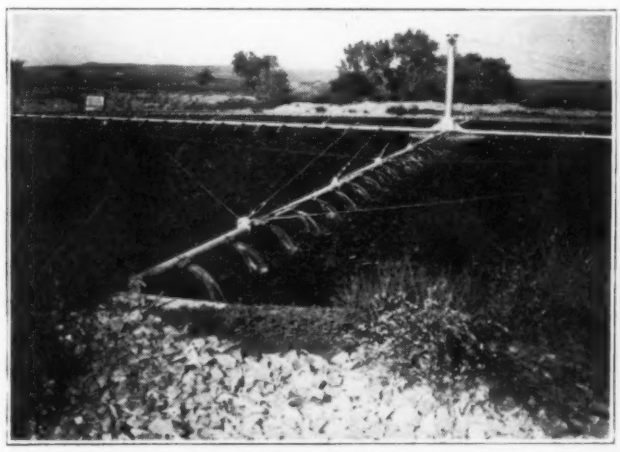
Definition of Capacities and Rates

The various types of trickling filters differ from each other in one or two respects; the total amount of work done, and the method used in applying the sewage to the filter surface. By using the term *capacity* we correctly distinguish between the amount of work done by the old conventional filter and its modern versions. These modern filters handle a much larger volume of sewage and remove a much greater amount BOD. per day for a given quantity of filter media than does the conventional filter. In other words, they have a greatly increased capacity.

The two general types of high-capacity filters differ from each other in one fundamental respect, namely, the manner in which the sewage is applied to the filter. If the sewage is applied as rain drops uniformly over the filter the flow



Rain Drop Application
(Low momentary rate)



Film Application
(High momentary rate)

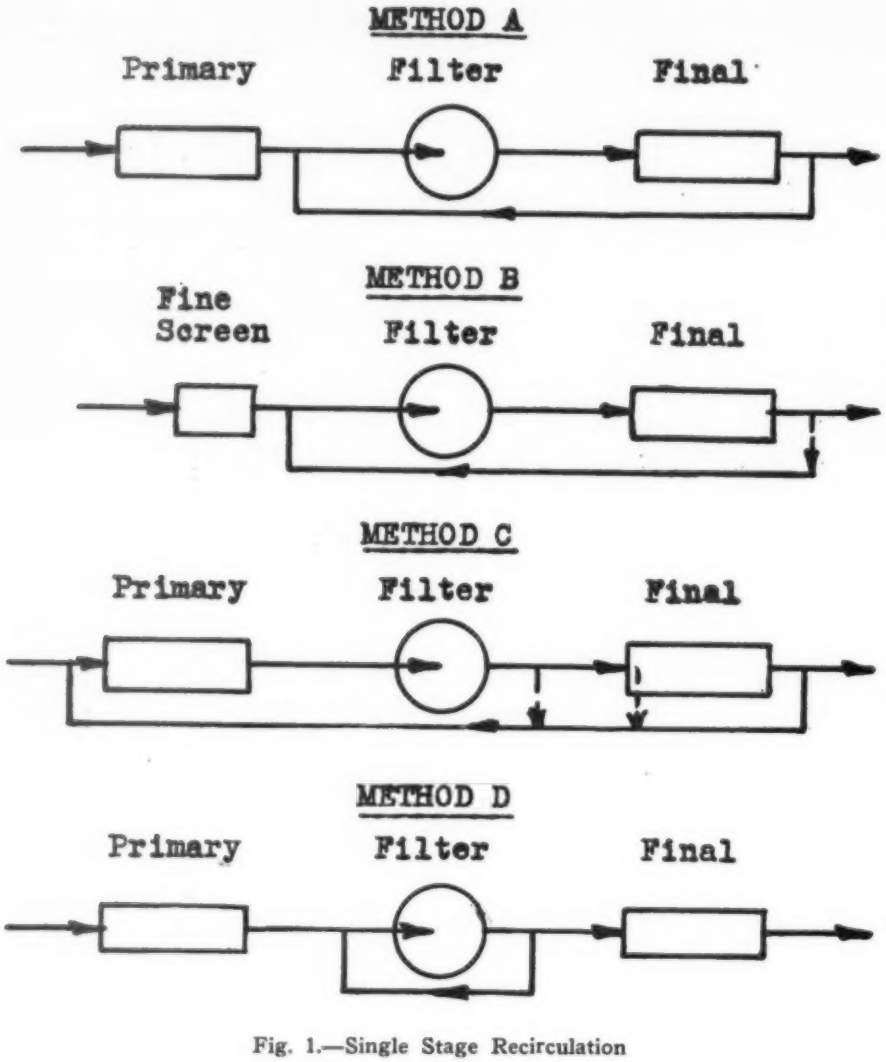


Fig. 1.—Single Stage Recirculation

upon any one area will be much lighter than if the same volume were being applied momentarily to two or three per cent of the surface; see accompanying photographs. A simple term to express this difference is the "momentary" rate of application. A more detailed discussion of rates and capacities has been previously published[2].

In accordance with these definitions the conventional filter has a low-capacity but a high-rate, the Aero-filter has a high capacity and a low (momentary)-rate, while all other modern trickling filters have high-capacities and relatively high (momentary)-rates of application.

The Aero-filter, with its rain-drop application and with filter loadings up to 2.0 lb. of BOD. per cu. yd. of media (settled sewage basis), requires no parallel recirculation to give an overall BOD. reduction of approximately 85 per cent through a single stage plant, if there is realized a 35 per cent removal by the primary clarifier. The other class of high-capacity filters uses parallel recirculation ranging from one to three times the raw sewage flow to give similar overall reductions.

A trickling filter automatically falls within the low (momentary)-rate field if the distributor applies sewage to any given filter radius at least once in every ten seconds by means of a relatively high revolving speed of the distributor, or if 10 per cent or more of the filter surface is momentarily dosed when the distributor is held in a stationary position.

Perhaps rain-drop application explains why a fixed nozzle conventional filter, which must of necessity have a non-uniform distribution over the total filter area by reason of circular sprays on a square or rectangular bed, gives as good results as a conventional filter using a rotary arm distributor employing film type application.

Recirculation

Fig. 1 shows the general methods currently used for recirculation. By parallel recirculation is meant recirculating liquid back through the filter one or more times in parallel with the flow of settled sewage. By non-parallel recirculation is meant using recirculation during low flows of raw sewage and then only in sufficient amounts to maintain from ⅔ to ¾ of the average designed flow for raw sewage in order to keep all of the distributor orifices in proper operation, regardless of whether the average is 10, 15, 20 or 30 mgad. In other words, parallel recirculation is used for dilution purposes, or to provide a longer contact between the sewage and the filter, whereas non-parallel recirculation is used to maintain proper distribution over the filter surface.

Whether recirculation is practiced from the final clarifier back through the filter (Method A of Fig. 1), or from the filter or final clarifier back through the primary clarifier (Method C), seems to make little difference. Marsten[3] observed at an Army Base that recirculation according to Method A seemed to give the best results. Aero-filter installations have used both methods with little, if any, advantage being noted, but Method A has now been adopted as standard practice for the Aero-filter.

Method D provides for recirculating filter effluent containing filter sludge directly back to the filter. At Dallas, Tex., this method of recirculation was practiced for a while with conventional filters, but it was abandoned in 1942 since the sludge tended to pond the filters and offset any gains that might otherwise have been made by the recirculation. The biological growth on the filter rock normally passes from the filter when it has reached the end of its usefulness; therefore, it seems unwise to return it to the filter and cover up the active filter life.

In Wilson's supplement to Walton's thesis[4] he points out that at Owatonna, Minn., when an attempt was made to run the first stage effluent direct to the second stage filter without intermediate settling, ponding of the second stage filter resulted.

Methods A and B (Fig. 1) provide a means whereby the load to the filters can be determined without including the recirculated BOD. This simplifies design data, for the designer of a filter plant is interested in at least two facts—first, what removal of BOD. can be effected by the fine screen, primary clarifier or Imhoff tank, and second, how much of the remaining BOD. can be removed by the filter and final clarifier.

According to Curve A of Fig. 2 an Aero-filter, with a good rock

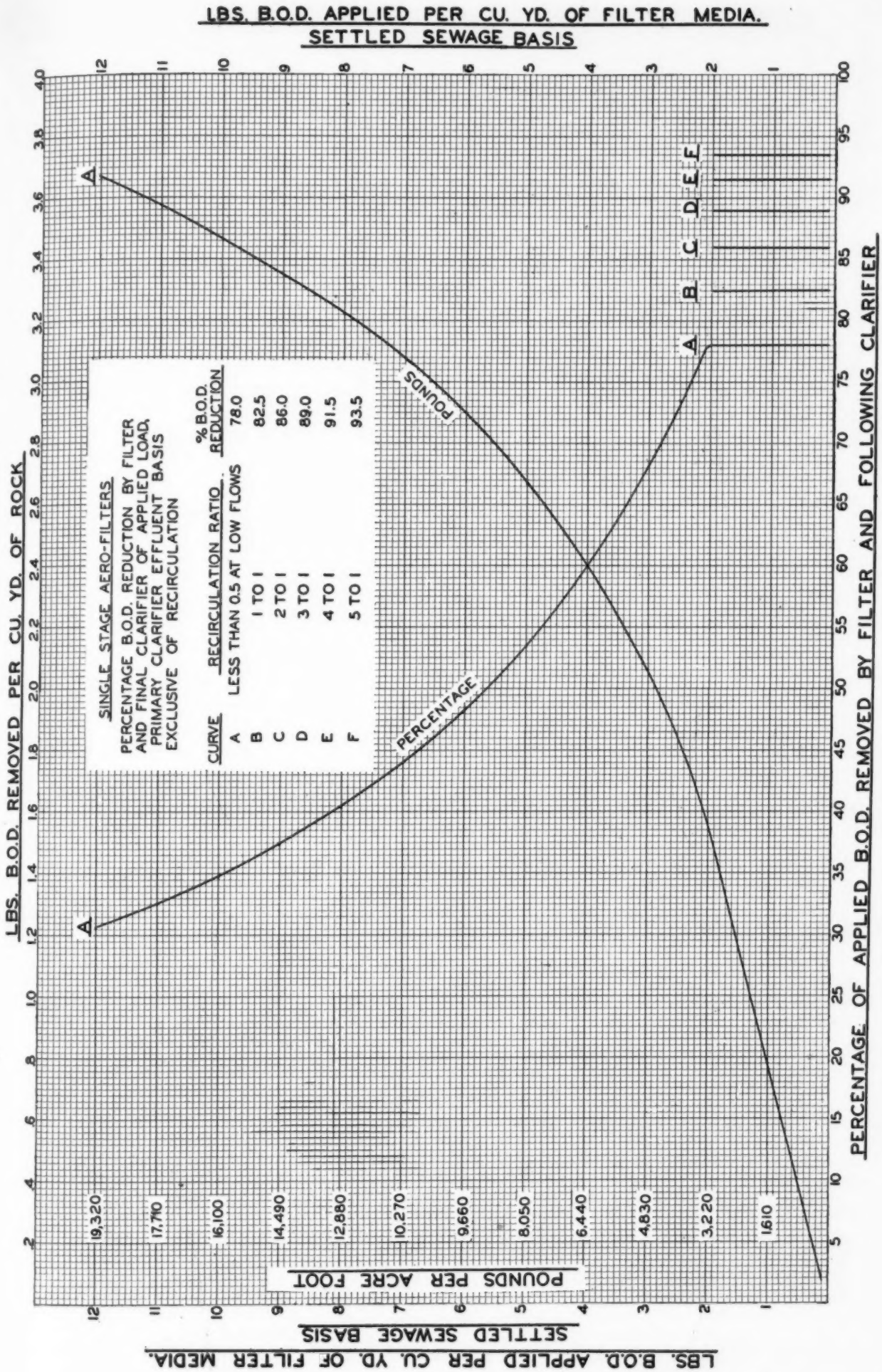

LBS. B.O.D. APPLIED PER CU. YD. OF FILTER MEDIA.
SETTLED SEWAGE BASIS
LBS. B.O.D. REMOVED PER CU. YD. OF ROCK
POUNDS PER ACRE FOOT
PERCENTAGE OF APPLIED B.O.D. REMOVED BY FILTER AND FOLLOWING CLARIFIER
POUNDS
PERCENTAGE
A B C D E F
SINGLE STAGE AERO-FILTERS
PERCENTAGE B.O.D. REDUCTION BY FILTER AND FINAL CLARIFIER OF APPLIED LOAD, PRIMARY CLARIFIER EFFLUENT BASIS EXCLUSIVE OF RECIRCULATION
CURVE | RECIRCULATION RATIO | % B.O.D. REDUCTION
A | LESS THAN 0.5 AT LOW FLOWS | 78.0
B | 1 TO 1 | 82.5
C | 2 TO 1 | 86.0
D | 3 TO 1 | 89.0
E | 4 TO 1 | 91.5
F | 5 TO 1 | 93.5
19,320
17,710
16,100
14,490
12,880
10,270
9,660
8,050
6,440
4,830
3,220
1610

Fig. 2.—Fundamental Relations Between Filter Loadings and Removals of BOD.

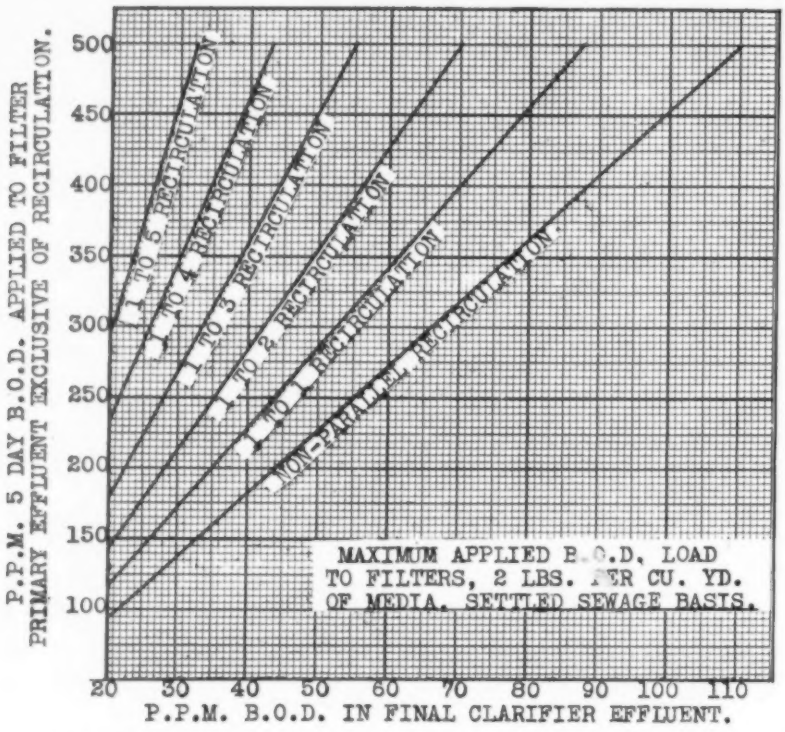


Fig. 3.—BOD. Reduction by Single Stage Aero-Filters and Final Clarifiers for Various Recirculation Ratios.

medium and without parallel recirculation, will provide a reduction of 78 per cent of the applied BOD. (settled sewage) through the filter and following clarifier up to a maximum load of 2.0 lb. per cu. yd. of rock. If one wants 30 ppm. in the effluent, the maximum strength applied cannot exceed 135 ppm. This would be equivalent to a 200 ppm. raw sewage BOD., provided the primary clarifier removed 35 per cent. To obtain a 30 ppm. BOD., in the effluent, in the case of stronger wastes, it will be necessary to use parallel recirculation, for single stage operation, in sufficient amounts to reduce the applied strength to approximately 135 ppm.

Methods of Increasing BOD. Reduction Through Trickling Filter Plants

There are several ways whereby a strong waste can be converted to one having a relatively low BOD. Recirculation to the filter will dilute the strength of the applied sewage. For relatively strong sewage, the effect of increased recirculation on the BOD. in the final effluent for single stage Aero-filters is shown in Fig. 3 based on settled sewage. (The curves in Fig. 3 are calculated from Fig. 2.) The data to be used in Fig. 3 may readily be obtained from Fig. 4 which shows the relation between sewage flow and BOD. of raw sewage for different per capita loads.

Heavy parallel recirculation has been used with the Aero-filters at Army Base B (Table I) because the flow of raw sewage has not been sufficient to keep the distributors properly functioning. Through use of 2.3 parts of recirculation to 1 part of raw sewage the overall BOD. reduction was raised from 85 per cent, which would be normal for non-parallel recirculation with a single stage Aero-filter, to 91.2 per cent. The primary effluent, which did not contain any of the recirculated liquid, had a BOD. of 225 ppm. and the final effluent 30.9 ppm. This BOD. removal checks with Fig. 3.

Increased BOD. removal in the primary clarifier means a weaker sewage can be applied to the filter which in turn should produce a lower BOD. in the plant effluent, e.g., a 50 per cent BOD. removal in the primary clarifier would reduce a BOD. of 280 ppm. to 140 ppm. as applied to the filter, in which case the final effluent should be between 30 and 35 ppm.

Single stage high-capacity filters followed by sand filters, contact filters or activated sludge, will normally provide a low BOD. in the plant effluent.

One should not expect the filter to remove 78 per cent of the applied BOD. when the sewage is very weak, since there is usually a residual BOD. in the final effluent of 10 to 25 ppm. This fact was revealed by Mohlman's work[5] at Chicago and by the data from Paris, Ill., Table II. The Paris plant, however, also handles storm flow. During wet weather the filter never functions as well as in dry weather. This is probably caused by mud coating the filter flora.

Installations of two stage Aero-filters have shown that approximately a 93 to 97 per cent overall reduction of the BOD. can be obtained without the use of parallel recirculation; hence, a two stage installation will give a 30 ppm. effluent with a raw sewage BOD. of 425 ppm.,

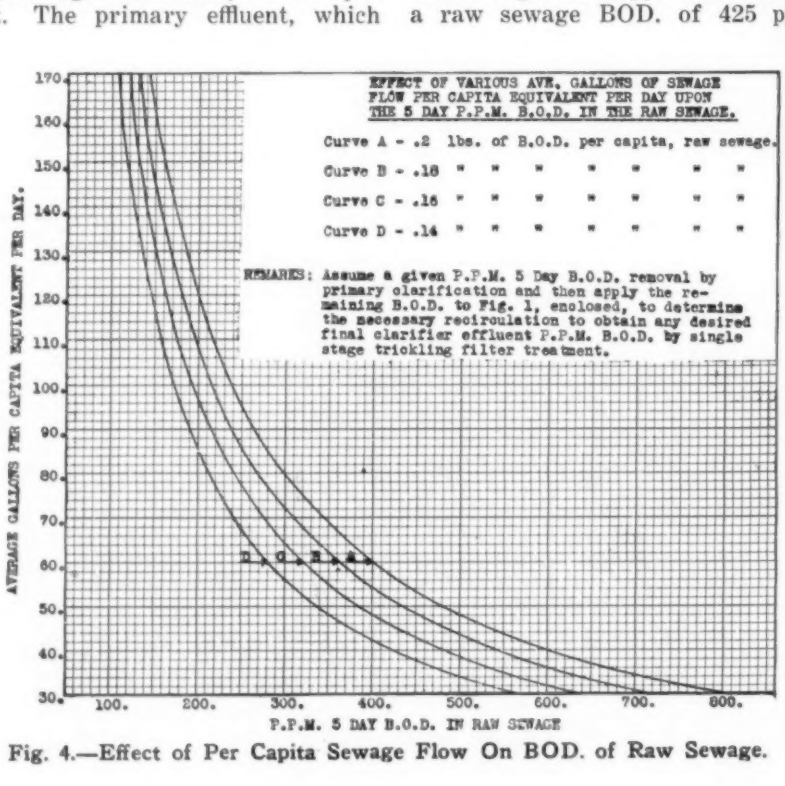

EFFECT OF VARIOUS AVR. GALLONS OF SEWAGE
FLOW PER CAPITA EQUIVALENT PER DAY UPON
THE 5 DAY P.P.M. B.O.D. IN THE RAW SEWAGE.
Curve A - .2 lbs. of B.O.D. per capita, raw sewage.
Curve B - .18 " " " " " " "
Curve C - .16 " " " " " " "
Curve D - .14 " " " " " " "
REMARKS: Assume a given P.P.M. 5 Day B.O.D. removal by primary clarification and then apply the remaining B.O.D. to Fig. 1, enclosed, to determine the necessary recirculation to obtain any desired final clarifier effluent P.P.M. B.O.D. by single stage trickling filter treatment.
AVERAGE GALLONS PER CAPITA EQUIVALENT PER DAY.
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
A
B
C
D
100. 200. 300. 400. 500. 600. 700. 800.
P.P.M. 5 DAY B.O.D. IN RAW SEWAGE

Fig. 4.—Effect of Per Capita Sewage Flow On BOD. of Raw Sewage.

whereas to obtain a 30 ppm. effluent by means of single stage filter from a raw sewage BOD. of 400 ppm. would require a recirculation ratio of about 3 to 1 part of raw sewage.

Naturally, as the quantity of recirculation increases the sizes of the clarifiers, interconnecting lines and recirculation pumps must also be proportionately increased. Fisher[6] has shown, by means of graphs, the relationship between clarifier sizes and recirculation ratios.

Removals Obtained With Heavy Loadings

When an excess of 2 pounds of settled sewage BOD. is applied per cu. yd. of media, the percentage reduction by the filters will decrease according to Fig. 2, which in turn will increase the ppm. BOD. in the plant effluent. Examples of these higher loadings can be seen at Carlyle, Ill., and Army Base C (See Table III).

Walton's tests (Table III) of the Aero-filter installations at Carlyle, Ill., are in agreement with curve A of Fig. 2. This plant handles a heavy milk waste, together with domestic sewage. During the tests Walton recirculated an amount equivalent to a ratio of 0.26 of the raw sewage flow, at low flows of raw sewage, from the final clarifier back through the primary clarifier. The calculated recirculated BOD. amounted to 57 lb. The primary effluent carried 663 lb. of BOD.

If we deduct the 57 lb. of recirculated BOD. there would be left 606 lb. applied to the filter, settled sewage basis, or 3.51 pounds per cu. yd. of rock. The final effluent contained 1.28 pounds of BOD. per cu. yd. of rock. Therefore, the removal by the filter and final clarifier amounted to 63.3 per cent of the theoretical primary effluent load, excluding the recirculated BOD. According to curve A of Fig. 2, at a loading of 3.51 pounds, the removal should have been 63 per cent. Hence, the plant was meeting the expected efficiency.

TABLE I

Army Base B, Located in a Cold Climate.
The effect of parallel recirculation on the percentage of BOD. reduction by single stage Aero-filter.

Dec. 1943 Date	Mgd. Raw	Mgd. Recir.	Mgd. Total	BOD. ppm. Raw	BOD. ppm. Prim. E.	BOD. ppm. Final E.	Suspended Solids ppm. Raw	Suspended Solids ppm. Prim. E.	Suspended Solids ppm. Final E.	D.O.
1	1.12	2.98	4.10	351	226	44	282	137	36	...
3	.95	2.98	3.93	342	169	39	282	119	26	...
6	1.14	2.94	4.08	370	228	28	318	140	41	7.8
8	1.16	2.92	4.08	451	264	25	344	119	38	...
10	1.20	2.84	4.04	430	255	45	400	137	37	...
13	1.08	1.61	2.69	340	207	21	220	80	17	...
15	1.22	2.35	3.57	327	217	21	220	94	18	4.6
17	1.03	2.38	3.41	370	240	18	244	101	28	...
20	1.11	2.42	3.53	294	209	36	198	118	19	...
22	1.19	2.42	3.61	381	232	32	224	83	19	...
Avg.	1.12	2.584	3.70	355	225	30.9	273	113	28	6.2

Average rate to filters including recirculation, 9.63 mgad.

Avg. lb. of 5-day BOD.
Raw sewage 3,300
Prim. effluent 2,110*
Final effluent 290
Avg. percentage BOD. reduc.
By primary clarifier 36.1%
By filter, primary effluent basis 86.3*%
By entire plant 91.2%

Avg. lb. of 5-day BOD. applied per cu. yd. of media
Raw sewage basis 0.761
Prim. effluent basis..... 0.487*
Avg. percentage S.S. reduc.
By primary clarifier 58.5%
By entire plant 89.7%

*Does not include recirculation since the return is introduced following primary clarifier.
Recirculation ratio 2.3 to 1 of raw sewage.

TABLE II.

Single Stage High Capacity Filters Using a Low Momentary Rate Produced by Centrifugal Nozzles.

Location of plant / Dates of tests	Paris, Illinois Nov.[4] 1941	Paris, Illinois Dec.[4] 1941	Paris, Illinois Summer (a) 1941	River Falls, Wis.[4] July, 1941	Owatonna, Minn.[4] April 6-10, 1942	Owatonna, Minn.[4] April 20-24, 1942	Owatonna, Minn.[4] April 6-10, 1942	Owatonna, Minn.[4] April 20-24, 1942	Lakefield, Minn.[4] August, 1941
Filter numbers					1	1	2	2	1
Test numbers	1	3 & 4	38 grab	1, 2, 3	12, 13, 14	16, 17, 18	12, 13, 14	16, 17, 18	1, 2, 3
No. 24 hr. composites	1	2	5	3	3	3	3	3	3
No. of filters	1	1	1	1	1	1	1	1	1
Mgd. Avg.									
Raw sewage	0.833	0.782	0.58	0.195	0.407	0.407	0.389	0.379	0.0518
Prim. clarif. effl., recirculation deducted	1.011	1.013	0.985	0.195*	0.407	0.407	0.389	0.379	0.0681(b)
To filters, including recirculation	1.011	1.013	0.985	0.195					0.0855
Final effluent	0.833	0.782	0.58	0.195	0.407	0.407	0.389	0.379	0.0681(b)
Recirculation ratio	0.213	0.296	0.75	0.0	0.00	0.00	0.00	0.00	0.26
Mgad. to filters	15.1	15.1	14.7	17.3	6.8	6.8	7.1	7.0	7.85
Ppm. BOD.									
Raw sewage	40	120	226	298	234	242	234	242	527
To filters, including recirculation	25	56	64.5	262*	182	204	182	204	369
Final effluent	14	24.5	19.5	69	41	86	73	108	68(b)
Pounds BOD.									
Raw sewage	278	780	1095	485	794	822	760	769	228
Prim. clarif. effl., recirculation deducted	189	452	463	426*	617	691	590	645	209
To filters, including recirculation	211	473	529						
Final effluent	97.3	159	94.5	112	139	291	238	341	38.7
Lbs. BOD. applied per cu. yd. of media									
Raw sewage basis	0.395	1.11	1.07	3.26	1.16	1.20	1.44	1.45	1.74
Prim. clarif. effl., recirculation deducted	0.27	0.64	0.66	2.86*	0.903	1.01	1.12	1.22	1.60
To filters, including recirculation	0.50	0.673	0.751						
Percent BOD. reduction									
By filters, prim. effl basis, recir. deducted	48.5	65.0	78.5	73.6*	77.6**	58.0**	59.6**	47.2**	81.5(c)
By filters, prim. effl. basis, recir. included	53.5	66.5	82.1						
By entire plant	65.0	79.8	91.5	77.0(c)	82.5	64.7	68.7	55.7	83.0
Ppm. D.O.									
Raw sewage	2.7	0.6							
Final effl.	7.8	7.4	4.5						
Ppm. nitrogen as nitrates									
Raw sewage	3.4	0.45		0.04					
Final effl.	5.4	7.20		0.30					

*Fine screen used instead of primary clarifier. Distributor poorly designed.
**Very poorly designed distributor replaced in the fall of 1944.
[4] Walton's data.
(a) Special series of tests over a two months' period.
(b) Includes fine screen wash water from city tap.
(c) Distributor was not in constant operation due to insufficient recir. capacity.

TABLE III.

Single Stage Aero-Filters Using Motor Driven Disc Distributors—Rain-Drop Application.

Location of plant	Lake Mills, Iowa		Carlyle, Ill.	Army Base C—Cold Climate 5 ft. filter depth, with a strong waste			
Dates of tests	Dec., 1939 (a)	Oct. 14-21, 1941[4]	Dec., 1941[4]	June 7, 1942	July, 1942	Aug., 1942	Feb., 1943
Avg. of test numbers		1, 2, 3	1, 2, 3				
No. of 24 hr. composites	1	3	3	1	month	month	month
Mgd. of Sewage							
Raw sewage	0.062	0.0923	0.287	0.143	0.2175	0.2170	0.320
Prim. effluent	0.1296	0.1126	0.363	0.143	0.2175	0.2170	0.320
To each filter with recirculation	0.1296	0.1126	0.363				
Final effluent	0.062	0.0923	0.287	0.143	0.2175	0.2170	0.320
Recirculation ratio	1.08	0.22	0.26	—0.3	—0.2	—0.2	—0.2
Mgad. to filter	14.8	12.8	27.5				
Ppm. 5-day BOD.							
Raw sewage	420	139	281	423	461	457	578
Prim. effluent	113	97	219	289	287	271	369
To each filter with recirculation	113	97	219				
Final effluent	39	34	90	85	119	115	220
Pounds of BOD.							
Raw sewage	216	107	673	505	835	827	1541
Prim. effluent, recirculation deducted	101	84	607	335	519	491	985
To each filter with recirculation	122	91	663				
Final effluent	20.2	26	215	101	217	208	587
Lbs. of BOD. applied to filter per cu. yd. of rock							
Raw sewage basis	1.91	0.948	3.99	3.13	5.23	5.2	9.7
Prim. effluent, recirculation deducted	0.895	0.735	3.54	2.11	3.26	3.1	6.18
To each filter with recirculation	1.08	0.798	3.93				
Percent BOD. removal							
By filter, prim. effl. basis without recirculation	79.2	69.5*	63.5**	69.9	58.3**	57.6**	40.3**
By filter, prim. effl. basis with recirculation included	83.8	71.1*	67.6**				
By entire plant	90.8	75.8	68.1	80	74.1	75	61.8

*Digester was giving trouble. **Load to filter is high. (a) Plant acceptance test. (4) Walton's data.

Comparison of Filter Efficiencies

Types of trickling filter plants are often compared by observing the strength and quantity of the raw sewage in conjunction with the plant effluent and the quantity of the filter media used. This, of course, is not a fair comparison unless the plants include the same features. Certainly, if one plant has special grease removal apparatus, aeration, flocculation, chemical coagulation or other special methods of pretreatment, or if one filter is followed by sand filters or their equivalent, much better results should be produced than with a plant not using these features.

A trickling filter should not be judged by the overall reduction of the BOD. through the entire plant, but each unit of the installation should be judged on its individual performance. In comparing trickling filters, the condition of the sewage as it reaches the filter should be noted. The ppm. of the BOD. applied to the filter, pounds of BOD. applied per cu. yd. of filter media, pH, oil, grease and scum all have an important bearing upon the plant results.

Walton's thesis[4] gives some of the basic principles underlying the Aero-filter as stated by Halvorson, its inventor, including the phrase "Filters dosed with a continuous rain-like spray." In drawing conclusions, however, Walton fails to differentiate between the results produced by filters receiving a continuous rain-like application and those which have the sewage applied in a film form.

Table IV shows some interesting comparisons of BOD. removals by conventional filters and high-capacity filters. Of particular importance are the results produced by the 84 ft. diameter by 8 ft. deep Aero-filter and the 1.5 acres by 6 ft. deep fixed nozzle filter at Spartanburg, S. C. These two filters operating in parallel receive sewage from the same sewer, the flow being split at the plant.

TABLE IV.

A Comparison of Efficiencies Produced by High-Capacity and Conventional Filters.

Spartanburg, S. C., has an 84 ft. dia. Aero-filter using rain-drop application in parallel with a fixed nozzle conventional filter operating on the same sewage. Hatch does not disclose whether the standard filter in his article is of the fixed nozzle or rotary arm type; neither does he give the amount of recirculation used with the High-Rate High-Capacity filter. Both of Hatch's filters have preaeration and final chlorination.

	Spartanburg, S. C.		Data by Hatch (7)	
	Aero-filter (Low-Rate)	Fixed Nozzle Filter	High-Rate High-Capacity	Conventional Filter
Dates of tests	Mar. 4 to June 2, '43		Jan. to May Incl., '43	
Diameter of filter, ft.	84	Rectangular	...	...
Square ft. area	...	65,240	...	...
Depth of filter rock, ft.	8	6	...	...
Total cu. yds. of rock	1,641	14,500	830**	14,700**
Number of 24 hr. composites	18	18	...	...
Raw Sewage Mgd.				
Minimum	1.375	.225	...	...
Maximum	2.814	4.035	...	...
Average	2.023	1.66	0.352	2.412
Mgad. Average Flow	17.4	1.1	...	...
Ppm., BOD. Avg.				
Raw sewage	430	384	322.6	286.8
Primary effluent	263	257	185.4	176.6
Final effluent	71	75	37.8	42.76
Pounds BOD. Average Flows				
Raw sewage	7,250	5,320	947	5,770
Primary effluent	4,440	3,560	545	3,550
Final effluent	1,200	1,035	111	860
Lbs. BOD. Applied, settled sewage basis				
Per cu. yd. of media	2.7*	0.245	0.657	0.242
Percentage BOD. Reduction				
By primary clarifier	38.8	33.1	42.5	38.4
By filter, primary effluent basis	73.8	71.0	79.6	75.7
By entire plant, average	83.5	80.4	88.2	85.0
Suspended Solids, ppm.				
Raw sewage	268	294	218.4	312.4
Primary effluent	127	138	116.8	146.6
Final effluent	48	68	34.4	40.84
Percentage Suspended Solids Reduction				
By primary clarifier	52.6	53	46.4	53.0
By entire plant	82.0	76.8	84.2	86.9

* Note: Loading to Aero-filter is in excess of 2.0 lbs. per cu. yd. recommended for the greatest percentage of BOD. reduction Check % reduction by filters vs. loads applied with loading curve, Fig. 2.
** Calculated by this author from the design data given by Hatch[7].

The Aero-filter, loaded at 2.7 lbs. of settled sewage BOD. per cu. yd. of media, gave a reduction of 73.8 per cent by the filter and final clarifier, while the conventional filter, loaded at 0.245 lb. per cu. yd., gave a reduction of 71.0 per cent. These results agree quite well with curve A of Fig. 2 considering the loads. The Aero-filter primary clarifier showed a BOD. removal of 38.8 per cent and the conventional filter primary 33.1 per cent.

Results published by Hatch[7] Table IV, for a conventional and high capacity filter show 75.5 per cent BOD. removal by the conventional filter of the applied settled sewage load of 0.242 lb. per cu. yd. of media, and 79.6 per cent by the high-capacity filter with an applied settled sewage load of 0.657 lb. per cu. yd. of rock. These results also correspond to the curves in Fig. 2. Wagenhals[8], in 1923, showed an overall reduction of the BOD. of 85 per cent through conventional filter plants including the primary clarifier.

Table V shows a series of BOD. results (146 consecutive 24-hr. composites) made during eight months at Lubbock, Tex. During the period an average daily load of 1.345 lb. of BOD. (settled sewage basis) was applied per cu. yd. of rock and gave an average removal of the applied load by the filters and final clarifiers of 78.4 per cent. The minimum average monthly removal by the filters amounted to 73.6 per cent and the maximum 81.9 per cent. The results correspond closely to Curve A of Fig. 2.

This single stage plant employs continuous rain-drop application. Non-parallel recirculation is used the last half of the night to augment the flow of raw sewage, with final effluent being returned directly to the filters.

Childs and Schroepfer[9] pointed out in 1931, by means of graphs determined from BOD. data gathered from nine large filter installations east of the Mississippi River, that the reduction by any given filter installation was constant, both for the pounds and ppm. of BOD. applied. This statement held true up to the limit of the data then available; 0.2 lb. of BOD. (settled sewage basis) applied per cu. yd. of media. The reduction for most of the nine filters averaged between 75 and 80 per cent based on the applied load. Eleven years later [10] (see curve A of Fig. 2) over 600 daily results from Aero-filters show that this same constant percentage of BOD. reduction holds good up to 2.0 lb. of applied load per cu. yd. of rock media.

If Childs and Schroepfer had had modern data available, they would likely have concluded that the limit for a constant percentage of BOD. reduction by a trickling filter should be nearly 2.0 instead of 0.2 pounds (settled sewage basis) per cu. yd. of rock.

Conclusions

1. The modern high-capacity filter is a refined version of the old low-capacity conventional filter, since both give percentage BOD. reductions of a similar order.

2. There are two general types of high-capacity filters. One gives results by the use of a continuous film type application to the filter in conjunction with relatively heavy parallel recirculation. The other depends on a continuous rain-drop application and requires much less recirculation.

3. Inferior results are most likely to occur if a plant is designed for rain-drop operation but equipped with distributors which employ film application.

4. Continuous operation of both low and high capacity filters is essential if maximum results are to be produced.

5. Both the pounds and parts per million of the BOD. applied to the filter must be considered in the design of a trickling filter.

6. Whether recirculation is practiced through the clarifier, in front, or following a filter seems to make little difference in the BOD. reduction.

TABLE V.

Lubbock, Texas. Single Stage Aero-Filters Using Rain-Drop Application.

Recirculation is used during low raw sewage flows, normally only at night, from final tank back to primary clarifier effluent trough.

	Months of 1942								
	Jan.	Feb.	March	April	May	June	July	August	Average
Avg. mgd. raw sewage	1.748	1.7667	1.764	1.805	1.9174	2.0017	2.211	2.178	1.924
Mgad. raw sewage, avg.	8.1	8.2	8.2	8.5	9.0	9.3	9.9	10.1	8.91
Estimated recir. ratio	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.36
No. 24-hr. composites	12	28	25	21	23	12	17	8	146*
Ppm. BOD.									
Raw sewage	286	427	439	473	496	479	480	462	443
Primary effluent	172	239	243	267	267	233	258	225	238
Final effluent	31.6	45.8	48.5	57.4	58	56	69	51	51.8
Pounds B.O.D.									
Raw sewage	4165	6302	6455	7115	7936	8023	8850	8370	7155
Primary effluent	2520	3525	3581	4016	4272	3894	4770	4080	3832
Final effluent	460	675	713	864	928	935	1255	925	844
Lb. BOD. applied per cu. yd. of rock									
Raw sewage basis	1.48	2.22	2.31	2.52	2.8	2.86	2.95	2.96	2.51
Primary clarifier effluent basis excl. of recir.	.893	1.245	1.285	1.42	1.51	1.375	1.68	1.442	1.356
Percentage BOD Removal									
By primary clarifier	39.5	43.8	44.6	43.6	46.3	51.7	46.1	51.2	46
By filters, based on primary effluent	81.9	80.8	80.6	78.4	78.9	76.1	73.6	77.2	78.4
Overall the plant	88.9	88.8	88.7	87.9	87.2	88.6	85.4	88.9	88.4

* Total.

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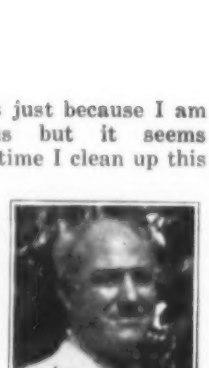
GOOD OPERATORS DON'T WORK*

A Story of Unorthodox Sewage Plant Operations That Seemed to Work

By CHAS. H. CAROTHERS
Consulting Bio-chemist
MIAMI, FLA.

"MAYBE it is just because I am superstitious but it seems that every time I clean up this place trouble starts.



The Author

This remark, in a slow southern drawl, by one of the operators of our three sewage plants at military camps here on the semi-tropical peninsula of Florida was an answer to my request that the operators observe and report everything, no matter how trivial.

Spotless Plants—Disappearing Sludge

We had been operating these three activated sludge plants with mechanical aeration for about a year with only indifferent success. According to the experts' directions, we had religiously pumped waste tanks and primary tanks once, twice, and even three times per day. We had worked with brush and hose to keep all tanks spotless and shining. We had scraped and dug algae from our splash plates. Algae in this Florida climate grows like weeds and clings, with diabolical cunning, to the galvanized iron plate.

We had done all of these things and yet with every peak load of soapy, alkaline water we were right back where we started with a grayish, non-settling, and completely unhealthy mixed liquor.

Fortunately, at that time our laboratory equipment for determining suspended solids in the final effluent had not arrived, but I shudder when I think what it must have been at times. You can imagine how we felt at having a suspended test on mixed liquor of say 600 when we started home at night and on arriving in the morning find we now had only 500 or even 450. "But the book says we should carry 800" is what you start to yell at the operator and then you stop for a small voice whispers in your ear, "He might ask *you* what he should do." "Besides," you reason with yourself, "You cannot bawl out a man for not knowing what you yourself do not know." (Especially in these labor shortage days). We should have written a mystery entitled "The Case of the Disappearing Slugs." (Note: the word "slugs" is a "cracker" colloquialism adapted from the word "sludge.")

To make a long story longer, we tried some of the well known palliatives such as prechlorination with indifferent success (we either added too much or not enough). And then against our better judgment, we tried copper sulfate. With this deadly bactericide we got good settling but the B.O.D.'s went crazy and stayed that way until we were able to culture another bacterial fauna.

Nitrification Stages Interesting

Here we made an observation and later verified it as we started up new aerators with plain raw sewage without benefit of any inoculation or culture from pre-activated sludge. This observation was to the effect that we could trace in this new raw sewage, day by day, the progress in the different steps of nitrification. The different stages of nitrification were like stair steps with each step distinct from the others: From the protein / to amino acid / to ammonia / to nitrite / to nitrate / each step was so distinct that the exact number of days each stage required, could be predicted ahead of time if certain operational requirements were complied with.

For instance, by using the curve of Theriault, as worked out years ago from observations of the behavior of B.O.D.'s over a period of months, the writer was able to predict almost to the day when the operator would be forced to switch from the Winkler method for dissolved oxygen to the Rideal-Stewart modification in order to obtain an end point for his titration of the D.O. test. It is well known that each of these stages has its own particular microbiological fauna, symbiotic in that the life and health of each stage depends on the life and health of all the stages preceding that one. Not only does the appearance of the aerator change from stage to stage, but all the laboratory tests change. The settling test, pH, D.O., Oxygen Consumed, B.O.D., Alkalinity, and CO_2 all change with the different stages.

For instance, from the 5th to 15th day we had very good settling. Then by the 19th day we had as pretty a case of bulking as you could wish to see. This bulking, or nitrite stage, continued until we were able to induce nitrate production.

Nitrate Production Accomplished

How we finally accomplished this nitrification to gain monthly average B.O.D. removals as high as 98.7 percent goes back to the beginning of this article and the sage observation of one or our operators as to the deleterious effect of plant cleaning. This remark brought to the mind of the writer a memory of some research done years before on the bio-chemistry of soils. When we cultured nitrate-forming bacteria in bottles, the bacteria, instead of being dispersed in the liquid, or forming a pellicle on the top, tended to cling to the sides and bottom of the bottle as a dark slime. That was the same dark slime we had been removing with brush and scraper from our aerators and the most important part; for that which we were removing was the part that was most active and enjoying the greatest oxygen supply. Then and there we stopped our scraping and brushing.

Now, we have a permanent culture of algae and bacterial slime that nature put there and it has operated to give our plants greater stability just as others have reported stability from higher concentration of solids in mixed liquor. (Maybe those trickling filters are not so bad, after all.)

We have, however, read of flies and larvae and blood worms, but we would not recognize one if we met it in the middle of the street. And if there is a particle of odor around one of our plants, we've yet to smell it or else we have been here so long we have lost our sense of smell.

Alkaline Peaks and Nature's Equilibrium

Now that we had our aerators good and dirty, we had given them greater stability—but we still had a problem in those aforementioned peaks of soapy, alkaline water. Until recently all three of our Army fields used untreated artesian well water. With a natural pH of 7.6, the soapy peaks would go up to 8.6 and 8.8. As long as our aerators were getting complete nitrification, however, the pH of mixed liquor never varied more than one-tenth of a point from 7.3. If the pH of the mixed liquor went up to 7.6 or 7.7 the plant was either bulking or on its way.

To me, no better demonstration of the marvelous workings of the equilibrium of nature is to be found than to watch an "8.6 influent" going into

*Presented before the Fla. Sew. Works Assn., this paper has been released by the Secy. of the Fed. Sew. Wks. Assn. for publication in *Water & Sewage Works.*

an activated sludge plant aerator and an exactly "7.3 effluent" coming out. How and why nature performs these miracles, we can as yet only guess. Could it be that she is endeavoring to protect our most important alkaline sensitive bacteria, the nitrate-formers?

In culture work with soils we found that the optimum reaction of these bacteria appeared to be about 6.8 to 7.3. That the total alkalinity of the water supply has a lot to do with these final hydrogen ion concentrations is attested to by the fact that at one field where we have recently started using aerated and softened water with heavy chlorination the final pH's at the sewage plant have dropped to 6.9 to 7.1 with nine out of ten of them at 7.0 This in spite of the fact that the pH of influent has gone up to 9.0 or 9.5 at times. Here we were faced with a real dilemma. We knew that no self-respecting aerator could stand a constant influent of 9.5 alkalinity and we own no re-carbonation equipment or other acid producing medium.

Tinkering With a Primary Tank

We still had one tank in the sewage plant which we were operating by the book and that was the primary tank. In the literature that has come to our hand, we have never read of anyone actually operating a *primary* tank, so we gave it a try. Since our object was to reduce the pH, we needed the production of CO_2 gas for re-carbonation, so—horror of horrors—we just stopped pumping sludge from the primary tanks. First we pumped every other day, then every third day and now we have one plant where the two primaries have not been pumped in thirty days. We have reduced the pH of the primary effluent from 9.5 down to 7.8 to 8.1. We should like a primary effluent of approx. 7.6 but the solid content of the raw sewage is not heavy enough.

Knowing that in nature are found bacteria which are highly acidifying (one at least is known that can produce a pH as low as 1.5) we are endeavoring to culture in this last named plant this type of bacteria in our primary tanks. That part of this drop in pH in our primary tanks is due to CO_2 gas which constantly bubbles up through the liquid is attested to by the fact that all our tests show a change in the primary from the carbonate and hydroxide of the raw sewage to bicarbonate before it flows to the aerators with 15 to 20 ppm. of excess CO_2.

There is no such explanation of the further drop in pH in the aerator, however, for we find (as reported by others in natural stream pollution surveys) that the dissolved CO_2 will be almost identical in final effluent samples as it was in primary effluent. At one plant using untreated water, without excessive alkalinity, the primary tank sludge is actually being pumped according to the pH of the primary effluent. When the pH drops to 7.6, sludge pumping starts.

How and Why It Works

Now, we did not jump into this primary tinkering without a lot of fear and trembling. The first thing we learned when we saw a sewage plant was a proper horror of "sour" primaries. They told us that our B.O.D.'s and suspended solids would go crazy and the whole place, including operation, would be fouled up. Yet, for over a year we fought these plants by day and read stacks of books on sewage and sewage treatment by night. We called on all the experts we knew—we even doubled the capacity of our plants—and yet we were tearing our hair out for fear the military inspectors would be around (our plant effluent at two fields flows in open ditches without any dilution for more than a mile). We were so desperate that we would have tried anything, including dynamite. Now we are running final B.O.D.'s *without* dilution water. Even *we* get suspicious when final B.O.D.'s drop below 1 ppm., as they have consistently of late.

Our only explanation of the success of this unorthodox operation is that enough oxygen is coming in with the raw influent to keep alive some aerobic and facultative anaerobes to break down the easily oxidizable carbohydrates and proteins with the production of acidifying CO_2 gas. When they have finished and before the true anaerobes (which are inhibited in growth by the oxygen present) can begin to break down cellulose, grease and proteins to produce methane and the vile and poisonous hydrogen sulfide, the whole mass will rise to the top where it is immediately skimmed off and pumped to the digesters. That is the secret of the process. When nature has finished with it at the bottom she pushes it to the top. That is the cue, for if it sinks again, you might have a digester instead of a primary tank.

And Practically No Supernatant Liquor

While speaking of digesters, how would you like to have only a few pails of solids out of 100,000 gallon flow and with practically no supernatant to worry you? Right here a word of caution. Do not, under any circumstances, let a particle of supernatant from the digesters get in that primary tank. If you do you will really have an awful mess. For some reason, supernatant seems to be deadly poisonous to those facultative CO_2 producing types of bacteria which have so carefully been cultured in the primaries, and instead of a gray, healthy, bubbling primary you will have a black, and wholly inert, foul smelling mess. That means—wash out or heavily chlorinate the primary and start over again.

Since using this system one of the operators said to me, "You know, I have about decided that if a man operates the primary in the proper manner, he can forget all about his aerator and go on home." That day I was a happy man, for although everybody in this world might say I was crazy there is one guy that is sold—up to his ears.

Acknowledgment

The writer wishes to acknowledge his deep appreciation to those officials and operators who with their patience and unstinting help made the foregoing possible: Thomas V. Davis, General Supt.; Lonzo D. Noble, Opr.; Horace L. Burton, Opr.; Earl Summerall, Opr.

[Ed. Note: While Mr. Carothers titles his paper, "Good Operators Don't Work," meaning they don't work at being too cleanly, we believe that Mr. Carothers has proved again that sewage is not the same in every municipality. Further, we believe that Mr. Carothers has also proved that good operators and supervisors do study the problems involved and adapt operation of the plant to the findings of their studies.]

The Wonders of Chlorine!

Now Credited with Revival of Dead City

From *TIME* magazine comes the story of the revival of Tombstone, Ariz.—and what revived it? None other than our green goddess, Chlorine. This old ghost town is now in the throes of a minor boom due to a medical center there featuring inhalations of chlorine gas for the treatment of arthritis, asthma, and sinus trouble.

The medical center, located in the abandoned Bank of Tombstone, was started by a Dr. Peter Paul Zinn, who got the idea from Father Roger Aull, a retired Passionate Priest, who himself was cured of an abscessed lung by chlorine inhalation treatments and who has since been treating others for ten years.

Dr. Zinn was not convinced of the efficacy of the treatment until his wife and mother-in-law, who had arthritis, were helped by Father Aull's chlorine machine. Whereupon, Dr. Zinn bought 14 chlorine producing machines and set up business in Tombstone.

Whether or not the treatment is medically sound, and whether or not those who come to sniff the chlorine are revived, certainly Tombstone is revived, what with all available houses, and two new tourists' courts full, the Crystal Bar in full swing and sightseeing tours doing a boom day business. Tombstone citizens are contemplating the erection of a permanent monument to "Chlorine—the Green Goddess"—destroyer of the living; protector of the living; and reviver of dead cities.

The Editor's Comments

Outstanding Developments of the Year Finds Waukesha in the Spotlight

When Leonard Thompson was invited to prepare the annual review of "Developments in Water Supply for 1945" for this issue, he accepted with fears that he would likely find it rather difficult to develop much of a progress review because of the sparsity of construction and new developments during the year passed. However, we think that Mr. Thompson has turned in a surprisingly interesting review considering the circumstances.

We are especially pleased to see that Arthur Gorman and his Water Division of the Office of War Utilities (WPB) has been accorded deserved recognition for the services rendered in the interests of Water Utilities and in the procurement for the water supply industry of the all important allocation of materials and equipment and the necessary priority ratings required.

Without question, one of the highlights of 1945 was the "Code of Practice" for water utility managements and employees developed by Harry Jordan for the AWWA Board of Directors, which approved and adopted it as the official "AWWA Code of Practice." Any reader who has not seen a copy of this code may have a copy by addressing a request to *Water and Sewage Works.*

To us, another milestone of high import on the road of progress in water supply was the acceptance of the new U. S. Public Health Service "Standards for Drinking Water" by the Am. Water Works Assn. as a standard for *all* water supplies, as revealed in the following resolution passed by the AWWA Board at its January meeting.

> "BE IT RESOLVED by the Officers and Directors acting for the American Water Works Association that the 1946 Drinking Water Standards proposed for adoption by the U. S. Public Health Service be voluntarily accepted by our Association as Standards for *all* public water supplies."

It will be recalled by many that the earlier Standards of the Public Health Service contained a number of specifications which were objected to by AWWA on the grounds of impracticability, if not impossible of compliance within the near future, and therefore untenable. Through efforts of the Association the Public Health Service has revised its earlier Standards so as to make them acceptable to AWWA, which voiced a desire for specific revisions in order that these Standards could be accepted as a National Standard for *every* public water supply.

Without question, the outstanding development during the year in water utility management, which we are pleased to find that Mr. Thompson has given conspicuous mention, is the profit-sharing plan adopted by the publicly owned Water Utility of Waukesha, Wis. This progressive management procedure, developed by Arthur P. Kuranz, manager for the Waukesha Water Utility Commission, constitutes the first case wherein a municipally operated utility has instituted a profit-sharing scheme for employes. This novel development was recorded by Mr. Kuranz for the first time in his article published in *Water Works & Sewerage* for February, 1945. We recommend its study by public utility managers.

There was some question concerning the legality of a profit-sharing scheme for a publicly owned utility, but now this has largely been dispelled as the result of the decision recently rendered by the meticulous Public Service Commission of Wisconsin, which body exercises strict jurisdiction over municipal as well as private utilities. That the green light has been given Kuranz and the Waukesha Utility Commission on their year old profit-sharing plan is evidenced in the following decision developed from facts gathered during hearings of the case:

> "THE COMMISSION FINDS AND DETERMINES that the employee profit-sharing plan of the Waukesha Water Utility is reasonable and just and consistent with the purposes of Chapter 196 of the Statutes."—*The Public Service Commission of Wisconsin. Jan.* 15, 1946.

Why We Change Our Name

Many will wish to know the answer to the question, "Why did we change our name?" The answer could be another question, namely, "Did we?"

When we say "did we?" what we might have said is that *WATER WORKS & SEWERAGE* and *WATER & SEWAGE WORKS* is saying one and the same thing, except that the term *Sewerage* is rapidly becoming archaic, while Sewage Works is a newer and more inclusive term and representative of modern practice. As a matter of fact, in its original usage, as encyclopedias and dictionaries continue to give it, Sewerage is "a system of sewers." Later day usage (but still not so defined in available modern dictionaries) has presumed Sewerage to be synonymous with Water Works and was so employed in the name of this magazine up to the present to indicate the complete sewerage system, including pumping stations and treatment plants. However, if Water Works has long been the accepted term for the complete water supply system, Sewage Works should unmistakably signify the complete sewage disposal system from the lateral sewers to the outfall. Thus it is that we prefer the modern term which should and very likely will replace the archaic Sewerage in time. While we had been contemplating a change in the name of *Water Works & Sewerage* to *Water & Sewage Works* with the turn of the year, we had our minds conclusively made up for us when the terms Sewerage vs. Sewage Works were discussed by the Board of Control of the Federation of Sewage Works Associations last October in Chicago. There being no concrete definition of the latter term, this Board developed one, to wit—

> **Sewage Works:** a comprehensive term including the collection, transportation, pumping, treatment and final disposition of sewage.

There was no mistaking the preference of this Board for the term Sewage Works over Sewerage, and the question of timing the change in name of this magazine was therewith answered for this writer.

Under its new name, readers and advertisers alike will hardly recognize any change from the well known characteristics of *Water Works & Sewerage.* However, improvements may be expected in quality of paper, increased number of reading pages, new editorial ideas, and broader coverage, all heretofore hampered by wartime restrictions.

L. H. Enslow

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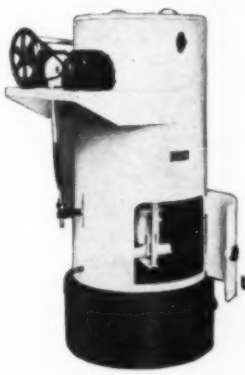

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UNCONDITIONAL GUARANTEE
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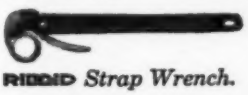
This means no more wrench housing repair expense!

● Pick up a RIDGID by the powerful comfort-grip I-beam handle and it *feels* like an unusually efficient wrench. It *is*. The precision-cut alloy jaws grip pipe firmly, let go instantly. Adjusting nut spins easily in all sizes, won't bind. You like the handy pipe scale on the full-floating hookjaw, the replaceable heeljaw. And the guaranteed housing assures you long expense-free service — most for your money. Ask your Supply House.



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How often has this happened to you
You've seen it happen —it's probably happened to you! The uncertainties of pipe ramming or jacking frequently end up in serious losses of time and materials.
"I'M OVER HERE, BUB"
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IT CAN'T HAPPEN WHEN YOU USE A HYDRAUGER
because Hydrauger drills and reams, clean, open-hole under accurate target-control. Hydrauger-ing avoids a tremendous amount of pavement-cutting, trenching, compaction, etc. Hydrauger-ing is the ideal way to install wrapped pipe, or any water or sewer lateral.
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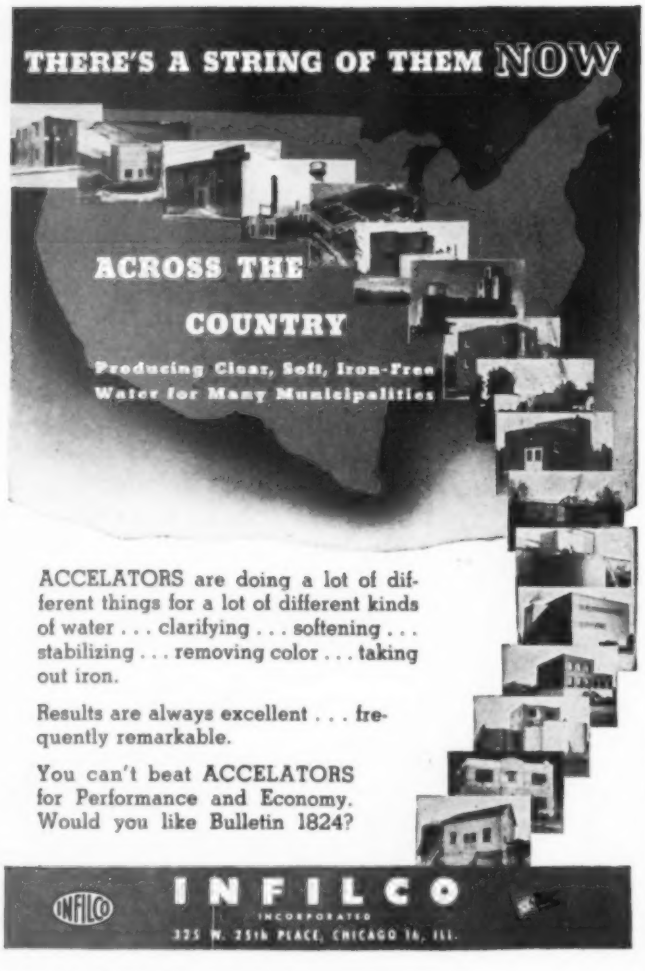
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MEETINGS SCHEDULED:

Mar. 1—NEW BRUNSWICK, N. J. (Hotel Roger Smith)
New Jersey Section A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N. J.

Mar. 14-15—MINNEAPOLIS, MINN. (Hotel Radisson)
Minnesota Section A.W.W.A. Sec'y-Treas., R. M. Finch, 416 Flour Exchange Building, Minneapolis, Minn.

Mar. 20-22—TRENTON, N. J. (Stacy-Trent Hotel)
New Jersey Sewage Works Association. Sec'y-Treas., S. A. Kowalchik, 427 Maple Ave., Trenton 8, N. J. [Note.—On Mar. 20th a pre-conference "Get-Together" will be held in the Stacy-Trent Hotel, beginning at 5 P.M.]

Mar. 21—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. (Monthly meeting.) Secretary, W. C. Conroy, 609 Statler Building, Boston, Mass.

Mar. 28-29—ELMIRA, N. Y. (Mark Twain Hotel)
New York Section A.W.W.A. Sec'y-Treas., R. K. Blanchard, 50 West 50th Street, New York 20, N. Y.

Apr. 2-3—LAFAYETTE, IND. (Purdue Memorial Union Bldg.)
Indiana Section A.W.W.A. Sec'y, C. H. Bechert, 402 State Liberty Bldg., Indianapolis 9, Ind.

Apr. 8-10—NIAGARA FALLS, ONTARIO (General Brock Hotel)
Canadian Section A.W.W.A. Sec'y, A. E. Berry, Director, Ontario Dept. of Health, Parliament Bldgs., Toronto 2, Ontario, Can.

Apr. 12-13—BUTTE, MONT. (Finlen Hotel)
Montana Section A.W.W.A. Sec'y, H. B. Foote, Director, Div. San. Eng., State Dept. of Health, Helena, Mont.

Apr. 15-17—FAYETTEVILLE, ARK. (Engineering Bldg.)
Arkansas Water and Sewage Conference. Sec'y, Harrison Hale, University of Arkansas, Fayetteville, Ark.

May 6-10—ST. LOUIS, MO. (Exhibits & Technical Meetings in Auditorium) (Accommodations in 12 Hotels)
American Water Works Conference. (Annual Meeting). Executive Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N. Y.

American Water Works Conference. (Annual Meeting). Executive Secretary, Harry E. Jordan, 500 Fifth Ave., New York 18, N. Y.

May 23-24—CORVALLIS, ORE.
Pacific Northwest Section A.W.W.A. Sec'y, Fred Merryfield, Oregon State College, Corvallis, Ore.

June 13-14—LAFAYETTE, IND. (Purdue University)
Central States Sewage Works Assn. Sec'y-Treas., J. C. Mackin, Route 4, Madison, Wis.

Sept. 16-20—POLAND SPRING, ME.
New England Water Works Assn. (Annual Meeting). Sec'y, W. C. Conroy, 609 Statler Bldg., Boston, Mass.

Oct. 7-9—TORONTO, CANADA
Federation of Sewage Works Assns., Exec.-Sec'y., W. H. Wisely, 625 Illinois Bldg., Champaign, Ill.

Oct. 14-17—GALVESTON, TEXAS
Southwest Section A.W.W.A. Sec'y-Treas., Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

$2,000 INVESTMENT PAYS $29,565 PROFIT

on a Flexible Pipe Cleaning Job

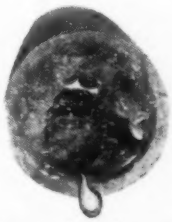
The above figures are actual investment and profit from a Flexible watermain cleaning job in one city.* The lines were cleaned in 1940 for a total cost of $2,000. During the past five years a constant ph has been maintained. Actual savings in pumping costs amounted to $18,250 over the five years' period. With an increase of 365,000,000 gallons of water pumped each year or 1,825,000,000,000 gallons total at 3½c per 100 cu. ft. the profit was increased $13,565 or a grand total of $31,565 less the $2,000 original investment.

Would your city be interested in an investment that pays 1,400 per cent? Let Flexible figure the cost of cleaning your mains. Write or wire today for details.

*Name of city furnished upon request.

What will it be?

A Trickle or a Torrent for new Homes in your city?



Flexible Service trucks complete with experienced crews and special Flexible-developed tools are strategically located in all sections of the U. S. A. to give pipe cleaning service quickly.

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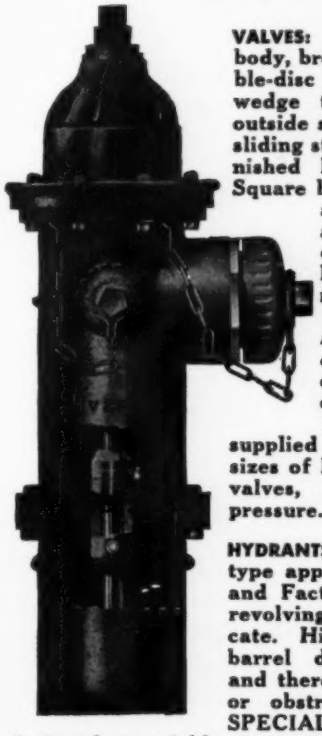

VALVES: A.W.W.A. type, iron body, bronze mounted with double-disc parallel seat or solid wedge type. Non-rising stem, outside screw and yoke, or with sliding stem and lever. Also furnished hydraulically operated. Square bottom type operates in any position. All rugged and dependable, made of best material with highest quality workmanship.

Hydraulically Operated: For remote control of operation and for quicker, easier opening or closing. Can be supplied in any of the standard sizes of M & H A.W.W.A. gate valves, either high or low pressure.

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NOW... QUALITY WATER

AT LOW TEMPERATURES

During winter months also, you can produce better quality water when you coagulate with an N-Sol Process. With the N-Sol Silicate processes of coagulation, the floc is large, tough, and rapid-settling, regardless of temperature.

Measurable results are lower turbidity, longer filter runs, increased plant capacity.

Before you complete plans for a new filtration plant, know more about the N-Sol Process for summer or winter coagulation. Complete information is available for the asking.

These processes fit any coagulating procedure — save space, save money.

N-Sol-A° — N Brand reacted with ammonium sulfate. Used where chloramine sterilization is desired.

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N-SOL PROCESSES FOR WATER COAGULATION

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Here and There with Doc Symons

Like Janus, the god of old, with one face to look backward at the old year and one to look forward to the new, let's contemplate the years of 1945-1946.

Skipping through the news items (in the back of **W.W.&S.**) for the past year, one notes the names of several water and sewage works men no longer with us, "Ned" Kingsley of Niagara Alkali, Denis O'Brien of A. P. Smith, John Sybrandt of Ludlow Valve, Charlie Eastwood of W & T, and Homer Turner of Anthrafilt, among others.

Honors came to Bill Orchard on his 30th anniversary with W & T and to Hal Hutton on his 25th with the same company; Hayes Kuhns also rounded out 25 years with Leadite.

Several of the "boys" were upped —Gerry Manahan to Sales Mgr. of A. P. Smith, R. E. Sprenkle to Hydraulic Engineer of Bailey Meter, Ethel Klingman (she's one of the boys) to Adv. Mgr. of Penn Salt, Jimmy Judge to Sales Mgr. of Neptune Meters, Johnny Horgan to Asst. Sales Mgr. of Ralph B. Carter Co.

Old faces seen once again included Dick Ford of Ford Meter Box, Berle of Innis Spieden, Larry Lingnor of *Water and Sewage Works*, and new faces included Lee Sudrabin, Chem. Engr. of Electro-Rustproofing, and Nick Carter, III, and Lew Klockner of R. B. Carter Co.

There were some other changes, too—Bill Johnson joined PEMCO; PEMCO changed its name to Rockwell Mfg. Co., and introduced a new meter; Bert Seeholzer went in business for himself as a Mfrs. Rep.; Bob Quinn went to Florida for Mathieson; Jack Radcliffe won the N. J. horseshoe pitching contest; Gordon Wiest went back to Albright and Friel; Mike Glace expanded his

consulting business and promptly broke a rib; Jo Quinn left the Ind. Bd. of Health to sell Klabber Girl baking powder; George Schroepfer went back to school—this time to teach; Albert Kozma left Rutherford; the CSSWA *Windmill* came out; Morse-Boulger bought Chem-Feeds (and Jeff Corydon went with it); Food Machinery bought Dayton-Dowd Pumps; Clayton brought out a hydromatic check valve; Matt Braidech left Case School for Fire Underwriters; "Bill" Hurlbut retired; Mark Owen joined a cons. firm in Indianapolis, and WSWMA moved to a new address.

Had you been a faithful reader of the columns in the back of *W.W.&S.* (besides "Here & There") you'd have known all the above news and more, for this was gleaned from the other stuff I wrote in 1945.

Looking ahead to 1946, I suggest you bite into a few of our Manufacturers' and Equipment News items and Literature and Catalog Reviews. I predict you'll find them interesting, informative and often amusing. Why shouldn't I predict it? I'll write most of them.

Also looking ahead, I predict that a great many persons, including this columnist, will have difficulty saying *Water & Sewage Works* for this magazine instead of *Water Works and Sewerage.* But I'll try to say and write it correctly, if you will.

I'm still looking forward to obtaining an article on the 13-month calendar and 1946 will see, I'm sure, more converts to the metric system (see next month for comments on my crusade). Now that paper restrictions are off, *Water and Sewage Works* should blossom with at least two new ideas in 1946 (besides the change in name), and I have definite hopes that the printing delay caused by the three-week strike in October will be overcome and *Water & Sewage Works* will come out on time—yes, I have hopes.

Reading the tea leaves in my cup (I take dry tea, you know), I can see more traveling to more conventions, that will have bigger attendances and better programs. Already I'm looking forward to the AWWA meeting in St. Louis and the FSWA meeting in Toronto. Yes, 1946 looks like a big year for Water and Sewage Works men. (P.S. Thanks to those of you who sent Christmas cards.)

* * * *

Have you heard that "Chuck" Velzy is teaching Hydraulics, Water Supply and Sewage Disposal at

Modern METER MOUNTINGS

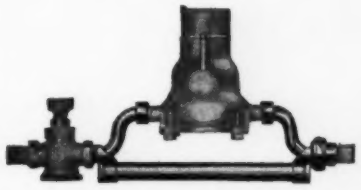
FOR ALL TYPES OF METER SETTINGS *in any Climate*

New!

Here is a COPPERSETTER which raises the meter only 2½″ above the service line level.

It makes available to the shallowest service all the important advantages of COPPERSETTERS mentioned below.

Excellent for basements also!



Shown here is the plain type but the valve type is also available.

The 70 series is made in heights for raising the meter from 6″ to 36″ above the service line.

The 90 series provides a flexibility in the spacing of connections to the service line.

The 80 series is installed on vertical riser pipes of copper or iron and is made in plain or valve types.

FORD COPPERSETTERS

These proven and perfected meter mountings provide many advantages in line with the modern trend in water service engineering. They are easily installed but last almost forever. All-copper water passages and easy bends insure hydraulic efficiency. Meter changes do not disturb the physical connection of the service, insuring trouble-free meter maintenance. COPPERSETTERS are made with and without valves and in a variety of types, sizes and connections which permits perfect tailoring to any job.

Ask for information about COPPERSETTERS—no obligation!

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The *Coagulant* that *Cuts Costs!*

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Ferri-Floc

Ferri-floc . . . the ferric coagulant that is successfully and economically used in sewage treatment throughout the United States. Take advantage of modern plant research and findings: use Ferri-floc. Tennessee Corporation's technical staff will be glad to help you with your specific problems. Write to us today. The consultation service is free, of course.

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ATLANTA, GEORGIA LOCKLAND, OHIO

Cooper Union night school in N. Y.? Wish I had time, I'd hop over to take the courses, too.

And L. K. Clark has resumed his position as Director, Sanitary Engineering Div. of the N. Dak. State Dept. of Health. L. K. rose to a Lt. Col. in the Army during his absence from N. Dak.

* * * *

In order to catch up on material for this column, delayed by the printers' strike in October, I'm holding comment on the Atlantic City meeting of the N. J. Sect., another Wendell La Due story, and a goodly number of other items.

* * * *

Whenever I can, I catch Don MacNeil's Breakfast Club over the ABC network from Chicago. One morning, Don, who always signs off, "Be Good to Yourself," was being maligned for that advice. Seems this lady was in a hurry to spend a $10 bill on being good to herself but was taking a few minutes to straighten up the bedroom while Don was still on the air.

By the time Don was signing off, the little lady had her hat and went to the dresser to pick up the ten spot. It was gone. "Why, it had been there not five minutes ago." Right there by the Kleenex which she had disposed of in the toilet! So that's why we used to find money down at the sewage plant. That fellow MacNeil must have a lot of listeners.

* * * *

Did you know that Roswell P. Roper of East Orange, N. J., who for more than 35 years has been developing forest preserves on his water shed and who was commended for that work by his governor, has recently had the pleasure of having his work written up in the *National Forestry Magazine* and his ideas used as a basis for a reforestation program for Italy. Now if he would just write that long promised article for W.&S.W.

* * * *

Charlie Murray of our Chicago Office ran across a story of a typhoid carrier in Panama who produces a virulent strain of Eberthella typhi. Said strain was being used by the Army medical center for the manufacture of typhoid vaccines for the Army.

Charlie says that's the only typhoid carrier he ever heard about who wasn't working in a dairy, hotel, restaurant, lunch room, or ice cream parlor, or making the chicken salad for the church social.

Speaking of typhoid, there have only been 30 or 40 typhoid cases in World War II out of 7 million or so men, while in the Spanish-American War there were 21,000 cases and 2,200 deaths out of 148,000 men in service. If that rate prevailed today there *would have been* 1,100,000 cases and 110,000 deaths. If we could only stamp out V. D. as well.

* * * *

The Great Gildersleeve is one of my favorite radio programs but I do wish "Gildy," as Water Commissioner, would join the AWWA and learn something about water works operations.

I don't know any water works man who know as little about the job as he does. If he'd come to the Convention in St. Louis next May, Springville's water service would improve greatly.

THE SPILLWAY

[Overflow from the main section]

Buffalo Annual Report

Buffalo, New York, sewage treatment works on the Niagara River continues to function for its seventh year (1944-45) despite shortage of personnel and material. There was no shortage of sewage flow, the actual pumpage increasing over the previous year due to the above-normal rainfall. Per capita sewage pumpage was 241 gpd. as compared with the seven year average of 233. Suspended solids removed increased over normal average as did the chlorine demand although the chlorine dosage was some 700 pounds less than the seven year average. Exhaustion of available dumping space near the plant site made it necessary to transport grit and ash to an area about six miles away. Because of the increase in haul, two additional trucks had to be used, greatly adding to the cost of disposal.

Expenditures during the year 1944 and '45 were higher than any previous period to date, caused by increased bonus coverage to include all grades of employees in the plant and operation. Total cost of $8.40 per million gallons was lower than the previous year due mainly to the increase in volume of sewage pumped, but the cost per capita, $0.739, was the highest cost to date. Laboratory operations were continued on a restricted basis because of wartime effects on personnel.

It is of interest to note that suspended solids content of 222 ppm. was equivalent to 0.45 lb. per capita per day. While this is 27 ppm. above the seven year average, it again emphasizes the fact that where a combined system is employed the use of a factor of 0.2 lb. per capita per day for design purposes is misleading.

Because of the high dilution the chlorine demand remained at 4.6 ppm., or approximately normal, and the addition of 4,390 lbs. of chlorine per day effected reduction in bacteria of 98.0 per cent.

On 203 days, when the flow was below 135 mgd. (i.e., dry weather flow) analyses showed the raw sewage to have a presumptive coliform bacterial content of 116,000 per ml. For the same days the effluent content averaged 1420 per ml.

Norwood Filters as installed at American Brass Co., Ansonia, Conn.

From Maine to Montana users are enthusiastic about Norwood Gravity Filters for municipal or industrial water purification service.

These efficient filters will remove pollution and foreign matter as well as practically all of the suspended material in the water. They may be combined with aeration and automatic chemical treatment to remove odors, color and objectionable chemical content.

Fifty years of specialized experience back every Norwood filter installation, yet latest engineering features make them modern as tomorrow.

Municipal or industrial officials, consulting or waterworks engineers are invited to ask our help on any water filtration problem, now or postwar.

W-1

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ENGINEERING COMPANY
25 N. Maple St.
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The Best For Your Money
NORWOOD FILTERS
In The Long Run

Industrial Alcohol from Sulfite Waste Liquor

In a comprehensive report entitled "The Economics of Industrial Alcohol," Professor R. D. Tousley of the State College of Washington estimates that the cost of producing alcohol from sulfite waste liquor will run from 15 to 19 cents per gallon, whereas the cost of producing alcohol from molasses would be 16 cents per gallon, and synthetically from ethylene at 10 cents or less per gallon. Alcohol from corn and wood waste would run from 20 to 23½ cents per gallon.

It is possible, believes Professor Tousley, that large sulfite liquors plants in the Northwest should be able to compete with molasses alcohol during peacetime if located close to markets and if the price of molasses does not drop below five cents per gallon. While the immediate postwar consumption of alcohol may remain high, its ultimate use is not likely to exceed pre-war levels. Under these circumstances it does not appear that there is much in favor of waste treatment of sulfite liquor waste to produce alcohol.

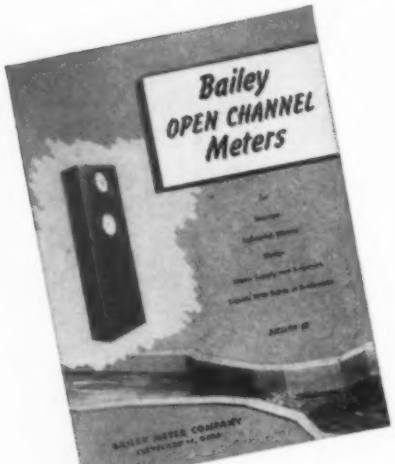
For trouble-free, low cost measurement of—

SEWAGE
INDUSTRIAL WASTES
SLUDGE
IRRIGATION WATER

BAILEY

OPEN CHANNEL METERS

Offer These Advantages:



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MU22

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VENTURI TUBES, FLUMES, WEIRS, NOZZLES, ORIFICES • DIRECT MECHANICAL AND REMOTELY LOCATED REGISTERS • AIR-OPERATED, ELECTRONIC AND ELECTRIC CONTROLS.

Mayors' Conference for Public Works Planning

At the December meeting of the United States Conference of Mayors, held in New York City, a number of resolutions were adopted proposing public works planning, and among those of interest to the water and sewage works field was the resolution concerning funds for public works planning.

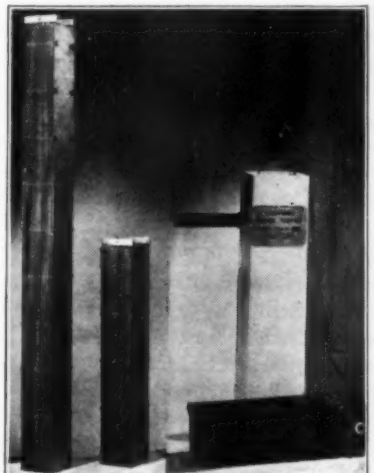
This resolution read as follows: "Whereas, the Congress of the United States in Title V of the War Mobilization and Reconversion Act of 1944 authorized Federal appropriations to be advanced to cities for the preparation of plans for public works to be undertaken in the reconversion and transition period, and Whereas, the amount of funds so far actually made available is so inadequate that the purpose of Title V of the Act has been completely emasculated; Now Therefore Be It Resolved, that the United States Conference of Mayors petition the Congress to appropriate sufficient planning funds to enable completion of a reserve of carefully planned projects which can be put into the construction stage, should such action be necessary by reason of economic conditions."

The Conference also resolved that it petition the Congress to make a definite and specific statement of policy covering all phases of Federal responsibility for financing public works designed to meet possible emergency conditions.

MANUFACTURERS' and EQUIPMENT NEWS

Stuart-Brumley Electronic Purifier

Fred Stuart of Stuart-Brumley, Baltimore, has come up with another idea. This one called the Electronic Water Purifier, does in a flash what older methods of coagulation require a good many minutes to do.



As Mr. Stuart points out this electronic (so called) coagulator is not to be confused with the well-known principle of electrolysis. This new equipment under the energy of a low impressed voltage, transfers aluminum ions from the aluminum grid plates "to the mineral salt content of the water thereby forming aluminum hydrous floc which removes color bearing colloids."

According to one theory this flash

coagulation is effective because of a combination of electricity and aluminum floc, both of which affect the electrostatic charges on the colloid particles.

As seen from the accompanying photograph, the working parts (these are models) consist of rows of aluminum plates between which the water flows while a low voltage is impressed across alternate plates.

Still in the experimental stage, the Electronic Purifier is proving effective in several small installations on different water supplies where data are being collected on cost of operation, life of the plates, and general effectiveness of the treatment.

C. G. Haney Research Engineer for Stuart-Brumley

Cecil G. Haney has been appointed to the position of Research Engineer of the Stuart-Brumley Corp., Baltimore. Mr. Haney, who is a graduate of the ICS course in sanitary engineering, spent seven years in the Stream Gaging Branch of the U. S. Geological Survey.

Cecil G. Haney

From 1940 to '45 Mr. Haney held the position of Water Plant Supervisor in charge of the water, trade waste, and sewage at the Radford, Va., plant of the Hercules Powder Co.

At Stuart-Brumley, Haney will have charge of engineering research, on new equipment for the water and sewage works field.

Clay Sewer Pipe Assn. Expands Program & Offices

The General Offices of the Clay Sewer Pipe Assn., Inc., will be located in the Huntington Bank Building, 17 South High Street, Columbus, Ohio, after February 1, 1946.

The Association has announced that an immediate expansion is being made in the Field Engineering Staff of the Association. The research and promotional work already carried on by the Association for the benefit of the engineering and architectural field, and the consumer market, as well as for the manufacturers of Clay Sewer Pipe and allied products, will be greatly intensified by the addition of new engineers. The additional field engineering personnel to be announced as soon as the current expansion program is completed, will be made up chiefly of World War II Veterans.

DO YOU HAVE A *Tank problem?*

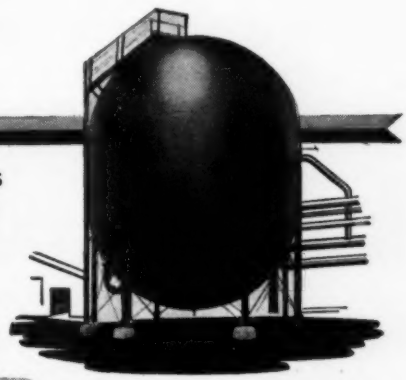
If you do we have the facilities to supply the answers regarding

★ **Tank Design**
An engineering department with experience and capabilities to tackle any practical size or shape, high or low-pressure tank, or special processing equipment.

★ **Tank Fabrication**
A factory capable of fabricating six million pounds of materials per month. Equipment includes the most modern forging, welding, shearing, punching and riveting equipment.

★ **Tank Erection**
Many unusual cost-reducing kinds of equipment specially designed by Stacey Brothers. We have erected thousands of tanks with capacities ranging up to ten million cubic feet.

A Stacey Brothers 1,500,000 cubic foot Dry Seal Gas Holder.



A Stacey Brothers vertical high-pressure tank.

★ **Special Structures and Products**
We design, produce and install literally hundreds of different kinds of special structures and products of aluminum, steel and steel alloys.

Stacey Brothers Gas Construction Co.
One of the Dresser Industries
5535 Vine Street Cincinnati, Ohio

Stacey Brothers TANKS

Reilly Tar's Aluminum Coating

An Aluminum Coating to give both beauty and protection to metal surfaces with only one coat has been announced by Reilly Tar & Chemical Corp., of Indianapolis, one of the country's largest manufacturers of coal tar products.

This new Reilly coating combines —in a one coat job—the attractive appearance of aluminum with the corrosion-resisting properties of coal tar. The aluminum pigment used is the finest quality of grade "A" (varnish grade) aluminum powder. This powder is thoroughly mixed into the coal tar base, and floats to the surface *after application*, giving a bright, lustrous aluminum finish.

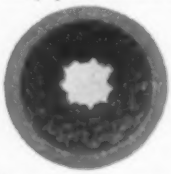
The coating can be either brushed

MORE WATER —LESS WORRY

by CLEANING your WATER MAINS using The NATIONAL METHOD

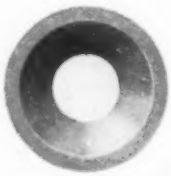
No need to worry about reduced water main capacities just when you need every gallon you can pump. Do as many other communities — large and small — are doing: clean those old clogged up mains by using the NATIONAL METHOD of water main cleaning.

We offer you (1) greater volume of water; (2) lower pumping costs; (3) improved pressure; (4) cleaner water land (5) reduced insurance rates.



Before Cleaning

★ The NATIONAL METHOD



After Cleaning

GUARANTEED TO RESTORE 95% ORIGINAL CAPACITY

The National Water Main Cleaning Co.

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115 Peterboro St., Boston 15, Mass. 210 E. Franklin St., Richmond 19, Va.
205 West Wacker Dr., Chicago 6, Ill. 7103 Dale Ave., St. Louis 17, Mo.
P. O. Box 683, Jacksonville 1, Fla. 501 Howard St., San Francisco, Calif.
3707 Madison St., Kansas City 2, Mo. P. O. Box 887, Waco, Texas
576 Wall St., Winnipeg, Can.

CRISPIN SEWER VALVES

A NEW Pressure Air Release Valve for Sewer Lines

Inlet sizes are as follows: 2" scr. or flgd., 3" ditto, 4" ditto, 6" flgd. only.

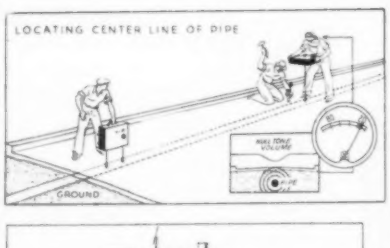
Designed by Crispin, a well-known name in Air Valves for Water Works systems, this new Valve for sewer lines will automatically relieve accumulating air and gases from force mains and other sewage equipment. It is suitable for all pressures up to and including 175 lbs. per square inch.

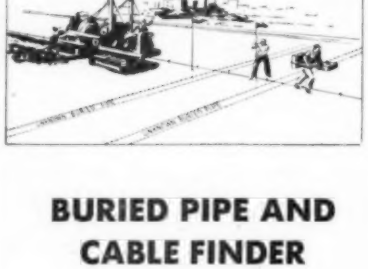
Outstanding features of the design permit a tight air seal at the top, with the float, actuating the levers, well away from working parts, thereby preventing sludge and other foreign matter from clogging the working parts. The ball rod runs through rollers permitting free action of the float without undue friction.

FOR INFORMATION WRITE

MULTIPLEX MFG. CO.
BERWICK, PA.

M-SCOPE





BURIED PIPE AND CABLE FINDER

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on or sprayed. It will not flow during or after drying. After drying it will not crack, check or peel on exposure to temperatures as low as minus 30° F., nor flow at temperatures as high as 160° F.

While designed primarily for use on metal surfaces which are exposed to the atmosphere, to excessive heat or moisture, chemical fumes and gases, and other corrosive agencies, Reilly Aluminum Coating may also be used on cement, tile, wood and brick surfaces.

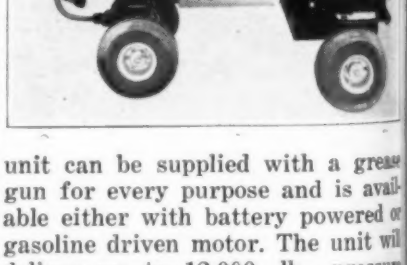
For descriptive circular, address Reilly Tar & Chemical Corporation, Merchants Bank Building, Indianapolis 4, Ind.

Koppers Acquires Wailes Dove-Hermiston

The Koppers Co., Inc., Tar and Chemical Division, has acquired the Wailes Dove-Hermiston Corp., producers of bituminous protective coatings. The main factory of Wailes Dove-Hermiston is in Westfield, N. J., and there are other plants in East St. Louis, Ill., and Houston, Tex., as well as district sales offices in principal cities throughout the country. Products of the Koppers Co. are closely related to those produced by Wailes Dove-Hermiston.

Portable Greasing Unit

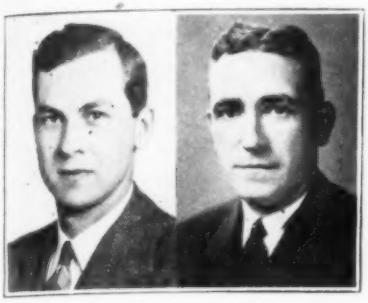
A new development in the lubrication field eliminates hand greasing operations. This portable greasing



unit can be supplied with a grease gun for every purpose and is available either with battery powered or gasoline driven motor. The unit will deliver up to 12,000 lb. pressure where and when you want it. This completely portable unit which provides on the spot lubrication for all rolling equipment as well as stationary equipment, such as valves, etc., may be obtained from Pressurelube Inc., 609 W. 134th St., New York 31, N. Y.

New Managers on Mathieson N. Y. Staff

John O. Logan has been appointed an Asst. Gen. Mgr. of Sales of the Mathieson Alkali Works and Harry P. Smith has been appointed N. Y. Dist. Sales Mgr., a post formerly held by J. B. Peake, who continues as Asst. Gen. Manager of Sales.



John O. Logan Harry P. Smith

Mr. Logan has been with Mathieson since 1931 when he joined the organization as a research assistant. Among Mr. Logan's achievements are patents on the generation of chlorine dioxide and the manufacture and use of sodium chlorite.

Harry P. Smith was Treas., Vice Pres. and Pres. of the George Chemical Co. before joining the Mathieson organization.

Diamond Alkali Expands Sales Organization

Diamond Alkali Sales Corp. has announced that effective January 1 it has taken over the operation of the Baltimore and Boston branches of Sunshine Soda Company.

The Baltimore branch will be merged with Diamond's Philadelphia district office located at 12 South 12th Street, of which C. F. Wolters, Jr., is manager. Messrs. H. A. Kurtz and A. DePhillips, former Sunshine Soda representatives in the Baltimore area, will continue to supply local service from Baltimore and Washington warehouses.

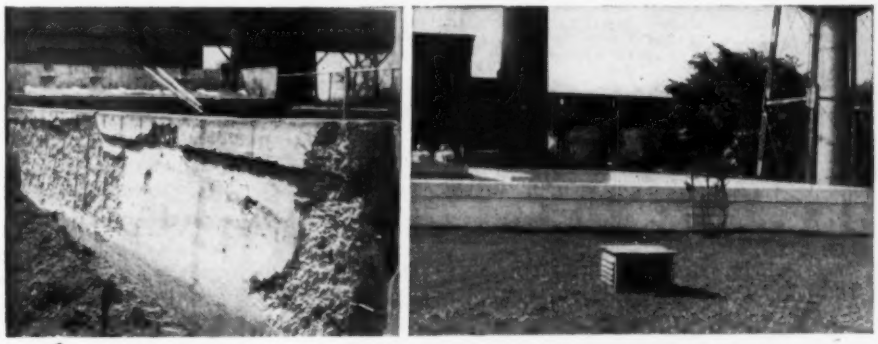
In Boston a new Diamond Alkali Sales office has been established to take over the operation of the former Sunshine Soda branch in that city. The offices are located at 80 Federal Street. Mr. H. B. Clark, formerly associated with Diamond's New York sales organization, will serve as Boston Branch Sales Manager.

Diamond Alkali Sales Corporation also announces the appointment of R. B. Perry as District Sales Manager of the Memphis office. Mr. Perry has been associated with the Diamond organization for some

CEMENT GUN COMPANY

"GUNITE" CONTRACTORS

GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



"GUNITE" SAVES COMPLETE REBUILDING

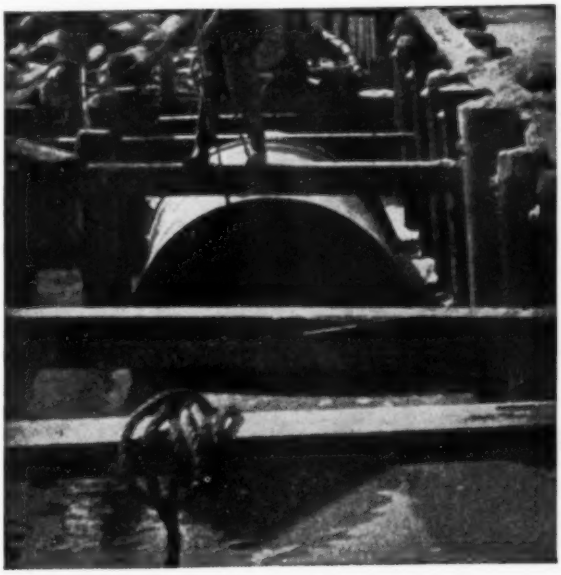
The above are "before" and "after" photographs of a sedimentation basin at the Water Works of the City of Batavia, New York, which we restored with "GUNITE" in 1944 under the direction of Mr. Fred F. Gordon, Consulting Engineer.

As shown on the left the original concrete walls of this basin were badly deteriorated. All disintegrated concrete was chipped out to solid surface and reinforcing mesh bolted in place. An average of more than two inches of "GUNITE" was placed on the inside and outside of the walls. Filter beds at the same plant were similarly restored.

Our 72-page bulletin C2300 describes this work and scores of other jobs where "GUNITE" has saved failing concrete structures of every description.

Write for bulletin C2300 today.

MANUFACTURERS OF THE "CEMENT GUN"



84" pipe—Spring Lake, N. J.

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FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.

11 Broadway, New York

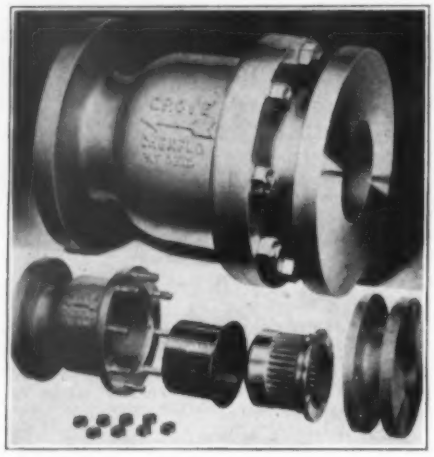
Warren Pipe Company of Mass., Inc.

years, and was recently released from service in the Navy, where he served as lieutenant in various combat areas.

New Grove Check Valve

Uses No Metallic Moving Parts

The Grove Chexflo Valve represents the utmost in simplicity and safety from the standpoint of design, construction and operation. Operation is effected by a synthetic rubber tube, stretched over a slotted, cup-shaped metal core, which expands to open and contracts to close.



Due to the fact that this expansible tube closes instantly on balanced flow, prior to the commencement of back flow, there is never any tendency to establish pressure impulses, shock or water hammer through the flow line. The flexive tube possesses a uniform and constant spring rate which avoids inertia being set up to cause operation beyond flow requirements. It likewise improves in service due to the fact that "flexing" adds life to rubber. Because of its self-compensating and wear resistant factors this unit is particularly suited for handling even the most highly corrosive and erosive air, gases or liquids. Full details contained in Bulletin 610 are available on request to Grove Regulator Company, 6581 Green Street at 65th, Oakland 8, California.

New Hooker Sales Representatives

The Hooker Electrochemical Co. of Niagara Falls, N. Y., has recently assigned Ralph E. Davis as its representative in New England, and Chas. Y. Cain to the sales territory in the vicinity of Chicago.

Mr. Davis, a graduate of Pratt Institute, has been with Hooker since 1941 as a salesman and consultant to the leather industry, a responsibility which he will continue to have.

Mr. Cain is a graduate of the Univ. of Maine, and has spent a number of years in the Niagara Falls plant and sales office.

Anthony Anable Back at Dorr

Lt. Cmdr. Anthony Anable, U.S.N.R., has rejoined the Dorr Co. as Director of Public Relations and Advertising. Commander Anable, known as "Tony" to his friends in the water and sewage works field, has been on military leave from the Dorr Co. since shortly after Pearl Harbor. As navigating officer of an aircraft carrier, Anable participated in four major naval actions in support of the invasion of Southern France, the Philippines, Iwo Jima and Okinawa.

WHO

GETS THE SEWAGE COMPLAINTS?

When sewer water, due to heavy rains or snow, backs up into the homes of your community, complaints generally follow. An easy way to solve this problem is to recommend the installation of a Josam Backwater Sewer Valve.

JOSAM SIDE-SWING BACKWATER SEWER VALVES

Function smoothly, safely!

Installed at proper points in the sewage system, Josam Side-Swing Backwater Sewer Valves keep backwater out of basements permanently. The flap valve in this exclusive device permits speedy drainage yet closes tight instantly at the slightest backflow. It is so inexpensive compared with the inconvenience avoided and damage prevented to property, equipment and merchandise that it should be installed without delay. For further information write for free folder on backwater control.

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JOSAM-PACIFIC CO., San Francisco, Calif. — *West Coast Distributors*
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They Will PROVE to You How GOOD They Are

PUMPS "by Aurora"

No matter how exacting your requirements, there is a size and type of Aurora Centrifugal or Apco Turbine-Type Pump to handle it PERFECTLY. Products of experience. Built by exclusive makers of fine pumps.

NSA Aurora Centrifugal Sump Pump

Aurora Deep Well Turbines for all conditions—4" to 24"

Type AD Hor. Split Case, Two Stage Centrifugal

Type OD Hor. Split Case Double Suction Single Stage Centrifugal

Type GMC Close-Coupled Centrifugal

Apco Turbine-Type Pumps
The simplest of all pumps. Ideal for small capacity, high head duties. Silent, compact and lasting.

Type GGU Side Suction Single Stage Centrifugal

APCO Horizontal Condensation Return Unit

APCO Single Stage Turbine-Type

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ORDER NOW YOUR CHEMCO CHLORINATORS FOR THE 1945 SEASON. IMMEDIATELY AVAILABLE AND PRICED RIGHT
-INVESTIGATE-
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REPRESENTATIVES IN PRINCIPAL CITIES

Fred Merckel's 25th Anniversary With W. & T.

Frederick G. Merckel, Executive Assistant of Wallace & Tiernan Industries, was honored by his associates at a dinner on January 2nd, on completion of twenty-five years with the Company.

Mr. Merckel graduated from Columbia University in 1916 with the degree of Civil Engineer. Following his graduation. he was connected with the New York Continental Jewell Filtration Co., leaving there to serve overseas in World War I as a lieutenant in the Sanitary Corps. After his discharge from the Army he was, for a short period, connected with the Permutit Co., then joined Wallace & Tiernan on January 1, 1921. One of his early assignments took him to the Orient to supervise the installation of a filtration plant for the City of Shanghai, China. He was subsequently appointed Dist. Mgr., with headquarters in Kansas City; and later Div. Mgr. with offices in Chicago, where he was located for many years prior to coming to Newark on his appointment to the executive group.

He is a member of ASCE, APHA, AWWA, and Tau Beta Pi. The dinner for Mr. Merckel was sponsored by the W&T Diamond Club, composed of employees who have ten years or more service with the Wallace and Tiernan Industries.

John Hart Returns to Neptune

After serving in the Armed Forces for three years, John C. Hart has returned to the Neptune Meter Co., as a Sales Engineer, with headquarters in the Kansas City office.

Mr. Hart, who was a 1st lieutenant, completed twenty-seven missions as a B-17 navigator with the 8th Air Force.

He is well equipped to handle his new position as he worked for Neptune for three years before entering the Army in 1942.

EDDY
FIRE HYDRANTS AND VALVES
WATER WORKS EQUIPMENT

EDDY VALVES
For
Water Works
and
Sewage Disposal
Plants

EDDY FIRE HYDRANTS
For Fire Protection Service

Write for Complete Catalog

Eddy
VALVE COMPANY
WATERFORD N.Y.

ODOR and TASTE are health factors too...

The WATER SUPPLY that pleases nose and palate is an important contribution to community health — people drink more of it.

ESOTOO* is the answer to a simple, sure, and more economical method of controlling residual chlorine — especially in "break-point" chlorination.

ESOTOO* is the Ideal De-Chlorinator.

**ESOTOO is "Virginia's" Trade Name for Liquid Sulfur Dioxide.*

V VIRGINIA

VIRGINIA SMELTING COMPANY

WEST NORFOLK, VIRGINIA

You'll wonder how you got along without this unique

DATA BOOK FOR CIVIL ENGINEERS

DESIGN

By ELWYN E. SEELYE

Consulting Engineer

Nowhere else in one volume today will you find all the design data that are concentrated in this book. Over 400 pages of plates cover the main fields of civil engineering—structures, sanitation, water supply, drainage, roads, airfields, dams, docks, bridges and soils. All information is graphically presented, so that diagrams, charts, illustrations, and numerous time-and labor-saving tables cover each point clearly and completely.

DATA BOOK—DESIGN will expand the field of activity of the experienced engineer. Inexperienced engineers will find that this book helps eliminate costly mistakes.

(1945) 417 Pages $7.50

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Please send me a copy of Seelye's DESIGN on ten days' approval. At the end of that time, if I decide to keep the book I will remit $7.50 plus postage; otherwise I will return the book postpaid.

Name .....

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Address .....

Employed by WWGS-1-46

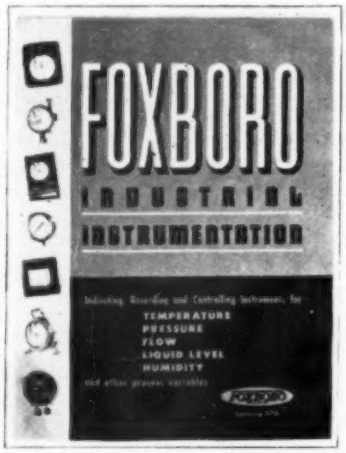
Rohan Opens Houston Office

The Rohan Co. of Waco, Texas, has opened a Houston office, according to an announcement from George J. Rohan, Pres. of the company. The Houston office will be under the management of Alan Love, formerly associated with several health projects in Texas. The new branch office will be located at 2518 Grant St. and will handle both sales and service of the same water works, industrial and municipal supplies as handled in the Waco office.

LITERATURE AND CATALOGS

New Complete Foxboro Catalog

The Foxboro Company, Foxboro, Mass., has just issued Catalog 370, presenting the company's full line of recording and indicating instruments for measurement and control.



Arranged for quick reference, and profusely illustrated, the sections deal with instruments for temperature applications, pressure, humidity, flow, liquid level, density, and other process variables. Control valves, planimeters, instrument accessories and supplies are included.

This catalog is the first in which Foxboro has been able to show its new line of "Dynalog" electronic instruments, the sale and use of which has, until recently, been limited to military applications.

A complete list of Foxboro's branches in North America and abroad is given. Copies of Catalog 370 will be sent on request to The Foxboro Co., Foxboro, Mass.

GOLDEN-ANDERSON

Design and Build

OVER 1500

TYPES AND SIZES IN

AUTOMATIC

VALVES

For Engineered Protection on any HIGH PRESSURE INSTALLATION

- **Make Golden-Anderson Valves your first choice on any new or replacement project—for maximum safety, dependability and protection.**

Descriptive Technical Catalog on request

GA

GOLDEN-ANDERSON VALVE Specialty Company

HERE IS A FIRE HYDRANT THAT OILS ITSELF

Every time you open a MUELLER-COLUMBIAN hydrant all working parts in the bonnet are given a bath by the oil in the reservoir. The packing gland is lubricated at the same time. Eliminates rust, corrosion, binding, and freezing. Packing never dries out. You can open or close this hydrant easily in any kind of weather — winter or summer. Only the MUELLER-COLUMBIAN has this EXCLUSIVE self-oiling feature. Demand it. Write for folder giving all the details of this better fire hydrant.

MUELLER CO.
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DECATUR, ILL. LOS ANGELES, CALIF

FINE SCREENS
FOR
SEWAGE TREATMENT

ADVANCED DESIGN
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COMPLETE INSTALLATIONS

THE NEW
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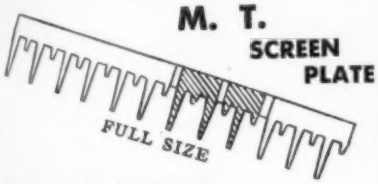

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HIGHER STRENGTH
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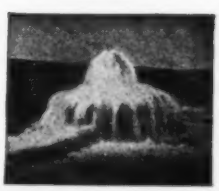
A Size and Type to Fit Your Problem in Water or Sewage Treatment.



WRITE FOR INFORMATION

A recent bulletin CCS-5M-645, issued by the American Car and Foundry Company, deals entirely with **a.c.f. Full Pipe-Area Lubricated Plug Valves.** These valves may be obtained in semi-steel, bronze, and other metals, and the bulletin contains full information on the lubricated plug valves, their advantages and uses for acids, caustics, chemicals, oil, water, and other fluids as well as for gas, air, and vacuum. Various styles of design and specification information are also given in the bulletin. Write to the American Car and Foundry Co., Valve Dept., 30 Church St., New York, N. Y., for this bulletin and other information on the uses of these valves and their appurtenances.

* * *

From Marlow Pumps, in Ridgewood, N. J., comes a new Bulletin No. M-45 on **The Marlow Mud Hog.** These diaphragm pumps are rugged individuals with non-clogging ball valves, easily accessible valve chambers, renewable valve seats, powerful steel walking beams, oversized pump bodies and heavy duty construction throughout.

The Marlow Mud Hog may be used for pumping water, mud, sand, ooze, slush gumbo, slime, grits and liquids containing trash. Sizes are available in 3 and 4-inch single and 4-inch double, with capacities of 3000 to 9000 gal. per hr. We'll bet these pumps would pump sewage sludge as well. Write to Marlow Pumps, Ridgewood, N. J., for Bull. No. M-45.

* * *

Writing in the **Taste and Odor Control Journal** for January 1946, W. A. Welch of the Industrial Chemical Sales Division, has an article on Labor Saving Innovations at Lancaster, Pa. Filter Plant. The article describes, with illustrations, how the decrease in manpower required was obtained by these innovations. At the present time Lancaster uses only six men to do the work formerly accomplished by nine, and these six men accomplish the work in less than one-third of the time. Pictured in the article are an elevator constructed from a one ton electric hoist, and a home-made paper baler. Small platforms are loaded with sacks of either alum or activated carbon, and these platforms built at approximately $15.00 each are effective not only in handling and moving these chemicals, but in storing them. A dust proof house and section fan encloses the

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AUTOMATIC VALVES

ALTITUDE VALVES • SURGE • RELIEF • BACK PRESSURE VALVES

FLOAT VALVES • REDUCING AND REGULATING VALVES

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Control of elevation and heads into and out of tanks, basins and reservoirs, hydraulic control.
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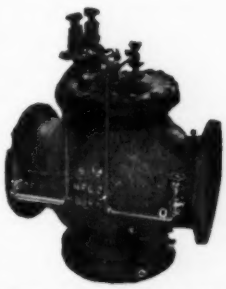
3. Combination assembly for three or more automatic operations.
4. Can be equipped with electric and manual controls.



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This valve will permit flow in one or both directions acting as
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2. Pressure Reducing and Altitude Valve.
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REMOTE CONTROL VALVE
Electric remote control—solenoid or motor can be furnished.
Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

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HYDRO-TITE — the self-caulking joint compound that makes cast iron water pipe joints — strong — tight — flexible and everlasting. Used on thousands of miles of pipe with a record of more than 30 years without a failure.

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FIBREX — The sanitary paper packing that is used like braided jute. Free from bacteria — treated with a water repellent — put up in 60 pound reels. 70 pounds of Fibrex takes the place of 100 pounds of braided jute.

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carbon feed hopper. This plant is operated under the direction of Charles P. Abraham, Superintendent of the Bureau of Water, and L. S. Duckworth, Superintendent of Purification.

* * *

No more threading, grooving or flanging, if you follow the advice in the bulletin on the **Rolagrip,** the advanced means for coupling pipe. This bulletin, issued by the designers and producers of Rolagrip, the Gustin-Bacon Manufacturing Co., shows the three simple parts—the gasket and the housing halves, held together by bolts, and by diagrams and photographs shows the means

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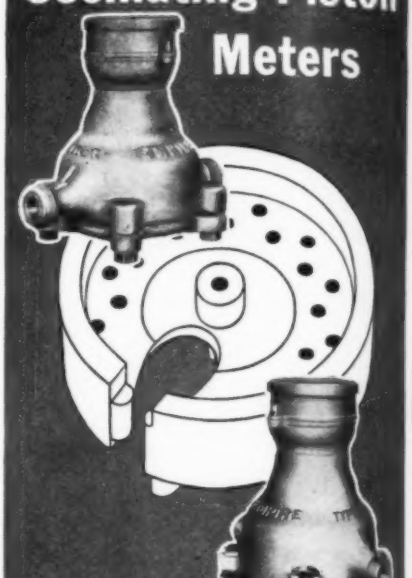
Oscillating Piston Meters



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Sales Engineer; graduate C.E., at present Sanitary Engineer Officer in U.S.C.G. Previous experience with U. S. Public Health Service and County Health Departments. Desires Southern California location; will travel. Box 2001, Water and Sewage Works, 330 So. Wells St., Chicago 6, Ill.

POSITION WANTED

CONTROL ENGINEER in water purification. Employed in this capacity for the past four years in forty m.g.d. filtration plant and sewage disposal system. Coll. graduate, Chem. major. West or Southwest preferred. Box 2002, Water and Sewage Works, 330 So. Wells St., Chicago 6, Ill.

POSITION WANTED

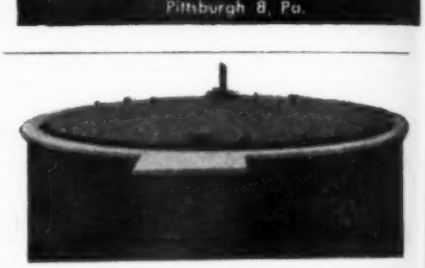
College Graduate with twelve years' experience in industrial and domestic water conditioning, including acidification, algae and slime control, chlorination, chloramines, demineralization, boiler feedwater (external, internal), iron removal, cooling water, settling and filtration, lime softening, taste and odor, zeolite softening, etc. 37 years old; married; Member of A.W.W.A. Address Box 2003, Water and Sewage Works, 330 So. Wells St., Chicago 6, Ill.

POSITION WANTED

As Superintendent or Assistant Superintendent in water works or sewerage plant or both. Fifteen years' experience in construction and maintenance of water mains and sewerage, deepwell pumps and power plant. Prefer Ohio or Indiana, but will consider other states. Now employed, but can be released in ten days. Box 2004, Water and Sewage Works, 330 So. Wells St., Chicago 6, Ill.

POSITION WANTED

Desire position as Water Works Superintendent, Plant Superintendent or Engineer. Age 38, Graduate Sanitary Engineer, Iowa University, member A.W.W.A., 10 years' experience in design and operation of coagulation and filtration, lime-soda and zeolite softening plants with considerable experience in chemistry, bacteriology and microscopy. Held position of Sanitary Engineer (Rank of Captain), U. S. Army, where extensive work was accomplished on sanitary surveys of water and sewage, public health problems in Military Government. Also 2½ years highway surveying and construction. Address Box 2000, Water and Sewage Works, 330 South Wells Street, Chicago 6, Illinois.



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Catalog No. 232 contains complete information, including specifications. Write for your copy.

P.F.T. PACIFIC FLUSH-TANK CO.
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by which the coupling acts, how tight enduring seals and controlled flexibility are obtained, and how quickly and easily these units are installed.

Accompanying the above bulletin is another called G-B Gruvagrip Pipe Couplings. This four-page bulletin shows these couplings for use on grooved-end pipe and their application to high pressure, low pressure, or vacuum lines.

Both of these products and the bulletins describing them may be obtained from the Gustin-Bacon Mfg. Co., Kansas City, Mo.

* * *

Designed to operate without mechanical linkage for transmitting force to the diaphragm, the **Oliver Diaphragm Slurry Pump,** as described in Bulletin No. 309 of Oliver United Filters, Inc., has a wide variety of applications. Listed in this bulletin are such things as metallurgical slurries, chemical liquors, crystalline products, acids, and food products. Not listed, but to our mind a possibility, is sewage sludge as well, of course, as ferric chloride, lime suspension or alum solution in water or sewage plants. While this pump produces an intermittent flow, the pulsations can be smoothed out by the use of an air chamber and a reasonably steady flow obtained. Proportioning is possible, and the pump can be obtained in special design. This bulletin and other information on the Oliver Diaphragm Slurry Pump may be obtained from Oliver United Filters, Inc., 33 West 42nd St., New York 18, N. Y.

* * *

Are digestion tank heating coils and the headaches that go with them on their way out in sewage treatment works practice? It looks that way from a new **P.F.T. Digester Heater and Heat Exchanger** described in a bulletin of that name issued by the Pacific Flush-Tank Co. The P.F.T. combined digester heater and heat exchanger provides a system of heating outside of the digestion tank, allowing complete accessibility with the entire heating and heat exchange being carried out in a compact unit with a high thermal efficiency. This new heat exchanger is described in Bulletin No. 135, which contains a complete description of the equipment, comments on safety control, method of firing, whether gas or oil, building heating, general operation, freedom from condensation

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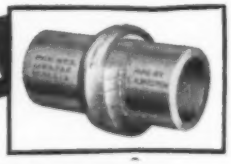

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and corrosion in the equipment, the piping arrangement required, circulation rate, and circulating pump capacity required. Also given are a table of data on sizes and comments on comparative costs. This Bulletin No. 1135, or additional information on the P.F.T. digester heater and heat exchanger, may be obtained by writing the Pacific Flush-Tank Company, 4241 Ravenswood Ave., Chicago 13, Ill.

* * *

On the front cover of the December issue of **The Pioneer,** published by the Niagara Alkali Co., is a picture of the laying of New York's first water pipes composed of pine logs. Inside the little 12-page booklet is the story of those first water mains, as well as stories on the Little Wonder Pipe Phone, side-suction centrifugal pumps, modern design, new uses for rayon, new uses for glass, and a number of new equipment units for laboratory and plant.

We were also delighted to see within this same issue a short item entitled "Kill That Fly!" Although this item does not say from where the information came, we are pleased to note that several paragraphs therein were excerpted from our article "Swat That Fly!" in our September, 1945, issue. *The Pioneer* may be obtained from the Niagara Alkali Company, 60 East 42nd St., New York 17, N. Y.

* * *

The Inertol Company, Inc., of 470 Frelinghuysen Ave., Newark 5, N. J., is revising its mailing list. If you are still interested in products for waterproofing concrete and protective steel, and you wish to be on that mailing list, write to the company for a check card. If you do, you will receive a four page folder showing **Inertol Products** and their uses as pictured by views of

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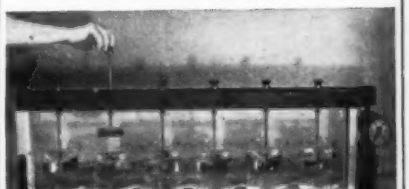

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WRITE FOR BULLETIN No. 602

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Do you like to go to the theater? Maybe you'd like to look behind the **Scenes from a Great Life.** These scenes are from one of the great plays of this country, not "Life with Father," but the life of George Westinghouse. The year 1946 marks the centennial anniversary of the birth of one of the industrial and mechanical giants that helped found the industry and production that has made this country great.

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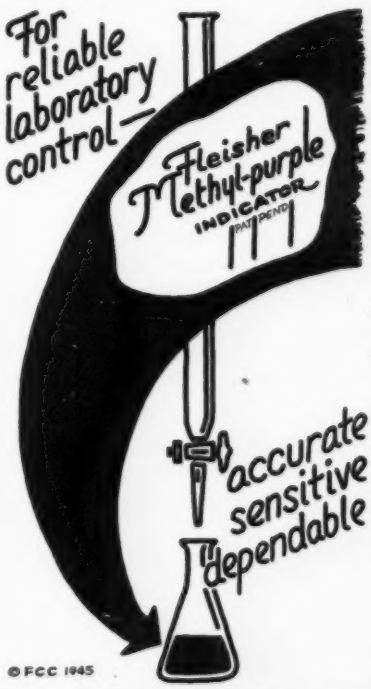

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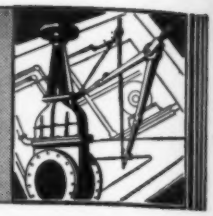

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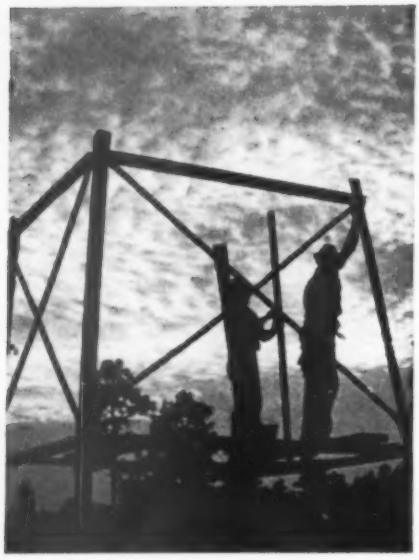

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Dorrco Doings in 1945

London, England
December 15, 1945

At the time of Munich, our small Company had intimate business contacts the world over to an extent in inverse proportion to our size. We had brought together a staff of engineers of a wide range of nationalities who worked together effectively and with good will. The war ripped up that fabric. But my first visit overseas since then is confirming us in the belief that before the war we were headed right. We propose to re-weave that fabric.

Science and business, as the war has now driven home to all of us, can be prime instruments of conflict and destruction. But the universality of science, and the human relationships of business can also make of them prime instrumentalities for understanding, cooperation and good will. We are determined to make, as a by-product of our business, our contribution to the atmosphere of reconstruction and mutual understanding which any visit overseas shows the world desperately needs.

MACHINE DESIGN AND INSTRUMENTATION

We have built new features into Dorr equipment, improving performance and operation, for example, a double-jointed lifting torq arm for the Dorr Thickener, and design and materials to prevent corrosion and abrasion in the Dorrco Slaker. We have applied extensive instrumentation, automatically indicating load and quality conditions such as Torq recorders for registering Thickener loads; strain gauges to constantly record performance within Tray Thickeners; Modutrol and Pressuretrol automatically gauging Dorrco Sizer products; and continuous, automatic quality indication for the Dorrco D-I System.

ENGINEERS AND EQUIPMENT AT WORK

A new use of Dorr Equipment—the Dorrco Sizer recovering iron fines from tailings—contributed to iron production on the Range and standard Washing Classifiers and Hydroseparators played their parts.

Sand producers, requiring closer, cleaner sizing for glass, specialty and concrete sands, installed Dorr Classifiers, Thickeners and Sand Washers in plant additions and new units.

A large United States cement producer advantageously installed new, heavy, modern design Dorr Washers to replace old units. In Central and South America, new plants using Dorr Classifiers, Slurry Mixers and Thickeners are under construction.

Maximum farm output to feed the world placed phosphates in heavy demand. New plants and additions with Dorr Hydroseparators, Classifiers and Sizers increased production and recovered fines formerly wasted.

Of dramatic interest is a problem solved in England, replacing batch washing by continuous counter-current washing in Classifiers. The granular product, delivered in nitric acid, was so unstable that all floors were kept flooded and windows were fine-screened against flies.

In the Sanitary field our work progresses with many small improvements and some large ones. For small sewage plants, the "two-in-one" Trebler Clarifier and a new Dorrco Digester combining gas storage and mixing in one tank are economical, efficient additions. In spite of war-time obstacles, Dorr equipment found its way to Argentina, Trinidad, Columbia and other countries.

Much advance has been made in Water Purification. Our work has extended from removal of granular silt, through colloidal solids to dissolved solids in present treatment processes. Dorr equipment in Louisville, Kentucky, Council Bluffs, Iowa, and Miami, Florida was put in service during the year.

Dorrco D-I Systems, familiar in water treatment, were applied to remove objectionable calcium, magnesium and sodium salts from sugar juices and corn syrups and to take off-flavor organic acids from fruit juices. The chemical and physical influence of foreign matter, infinitesimally present in solutions, has opened wide research fields.

Our contribution to overcome sugar shortages here and abroad has been reduction of losses, improvement of yield and quality with the Continuous Carbonation Process, Dorr Multifeed Cane Juice Clarifiers, and Oliver-Campbell Vacuum Mud Filters.

For Pulp and Paper production, the largest Dorr Monorake Clarifier ever built—350 feet long and 80 feet wide—treats the water for a Southern mill and, in Canada, a Dorr Hydrotreator handles a 20 m.g.d. water requirement. The Dorr Continuous Causticizing System went into two new Canadian mills, and our work even included engineering and equipment for a new installation in India.

PROCESS AND PLANT IN THE MAKING

To us the techniques surrounding solids suspended in gases are becoming as familiar as the behavior of solids suspended in liquids. Our Fluosolid Process experimental and pilot plant program has developed that knowledge from work on iron ore reduction, limestone calcination, lime sludge reburning and sulfide ore oxidation. Close temperature control, a feature of the process, suggested selective oxidation or reduction required in pigment production and in calcining one carbonate without calcining another accompanying one. Certain applications may be ready to offer in late 1946.

Our Semi-Works Plant, completed last year, and our Laboratories have made us useful to an increasing number of organizations large and small. Their Research units having originated process possibilities, The Dorr Company has economically provided engineering analysis and practical pilot plant demonstration. Saving our clients both time and cost, an especially qualified technical staff has carried through confidential work on several projects both in the organic and inorganic fields, translating laboratory-scale intermittent methods to pilot plant quantities in continuous production.

Process and Design Engineers in our organization supplement our development and semi-works activity and, within our field, have undertaken work ranging from accumulation and analysis of factors affecting economical operation, through preliminary and final process recommendations and layout to war-time responsibility for design of process and plant. In 1945, to list some of the projects, we laid out process and specifications for recausticizing spent lime in pulp digestion in Canada and for beet sugar juice purification in Russia; our design work included alumina facilities in Australia, Brazil and China and nickel production in Cuba.

Our Company has gone through two great wars, troublous depressions and many lesser trials. A new wealth of talent has come to our engineering family. Our technical resources have been increased and our work has gone forward in a spirit of professional partnership within our organization and professional service to our clients. For all this we are grateful to our friends whose support made it possible. To them and to Dorr men everywhere, The Dorr Company extends New Year's Greetings, with the hope that 1946 will go far to bind up the wounds of war and at least set us on the road to that world unity, indicated by the devastation of war, underlined by the atomic bomb as being probably more important to each of us than anything else.

John V. Dorr

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1077

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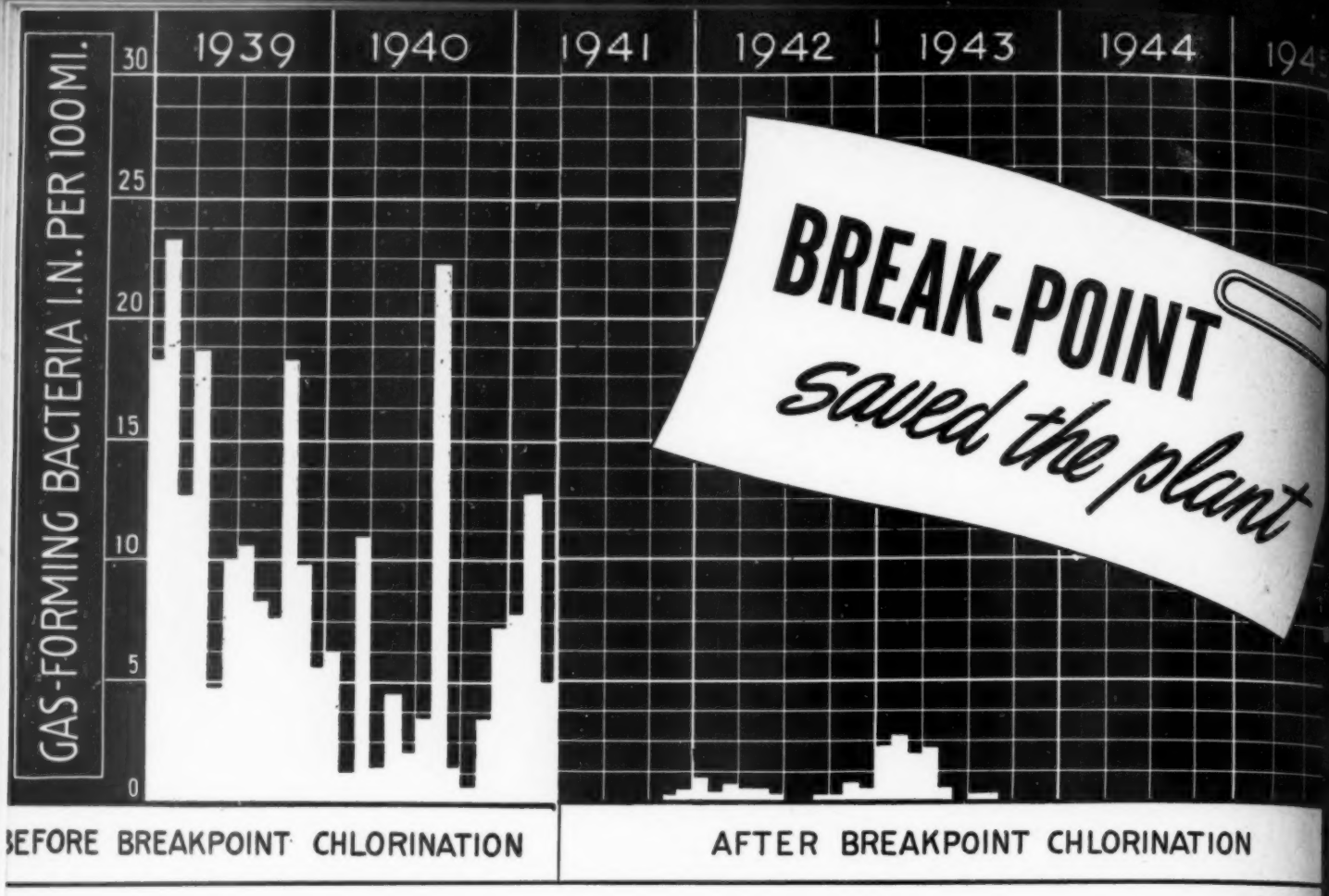

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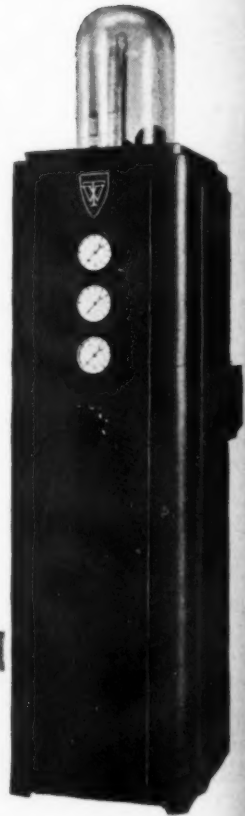
Safer, more palatable water, may be one of the civic improvements your citizens will expect soon. To be ready, check now with your W&T Representative on what Break-Point Chlorination can do for you.

BACTERIOLOGICAL DATA

	BEFORE B-P CHLOR.	AFTER B-P CHLOR.	CHANGE
Total Bact. per ml (avg.)			
Raw	225.	307.	+36.0%
Filtered	10.8	0.3	−97.2%
Finished	0.90	0.57	−36.6%
I. N. (Indicated Number) Gas-forming Organisms per 100 ml			
Raw	1769.3	2554.8	+44.3%
Settled	10.418	0.591	−94.3%
Filtered	0.697	0.047	−93.2%



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